DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-161642

SOLAR HOT WATER SYSTEM INSTALLED AT LAS VEGAS, NEVADA - FINAL REPORT

Prepared from documents furnished by

LaQuinta Motor Inns, Inc.
Post Office Box 32064
San Antonio, Texas 78216

Under DOE Contract 77-G-01-1654

Monitored by

National Aeronautics and Space Administration
George C. Marshall Space Flight Center, Alabama 35812

For the U. S. Department of Energy

(NASA-CR-161642) SOLAR HOT WATER SYSTEM INSTALLED AT LAS VEGAS, NEVADA Final Report (La Quinta Motor Inns, Inc.) 40 p HC A03/MF A01 CSCL 10A

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U.S. Department of Energy

Solar Energy

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APPENDIX A

ROOF PLAN/SOLAR

FOR

LA QUINTA MOTOR INNS, INC.

LAS VEGAS, NEVADA

A. Collectors

The collectors chosen for this project were single glazed Model SG-18, manufactured by Raypak, Inc. A total of 56 collectors were used. The collectors were supplied with Model PR-18 Solar Panel Rack Kit. (See attached sheets on Raypak collectors.) All the collectors were orientated due south at a 46° tilt to maximize for winter solar collection.

B. Storage System

A 2,500 gallon insulated vertical steel storage tank was located outdoors next to the Inn's cooling tower. A temperature sensor was installed in the storage tank for control function. To improve heat transfer between the heat exchangers and stored water, a 1/12 HP Grundfos recirculating pump was installed.

C. Heat Exchangers

Two heat exchanger tube bundles were mounted into the storage tank. The upper heat exchanger which served to extract heat from the storage tank to the domestic hot water system was sized for 100 gpm at 10°F temperature rise. The lower heat exchanger which served to transfer heat from the solar collectors to the storage tank was sized for 51 gpm at 10°F temperature drop.

A solution of ethylene glycol was used as heat transfer fluid between the solar collectors and the lower heat exchanger. With the use of the upper heat exchanger for the domestic hot water system, a double wall separation was achieved between the domestic hot water system and the ethylene glycol.

D. Pump and Controls

Two solar loop pumps, each sized for 100% of the solar system requirements were installed. The pumps are controlled by a temperature differential controller with an alternator for equal usage of the pumps.

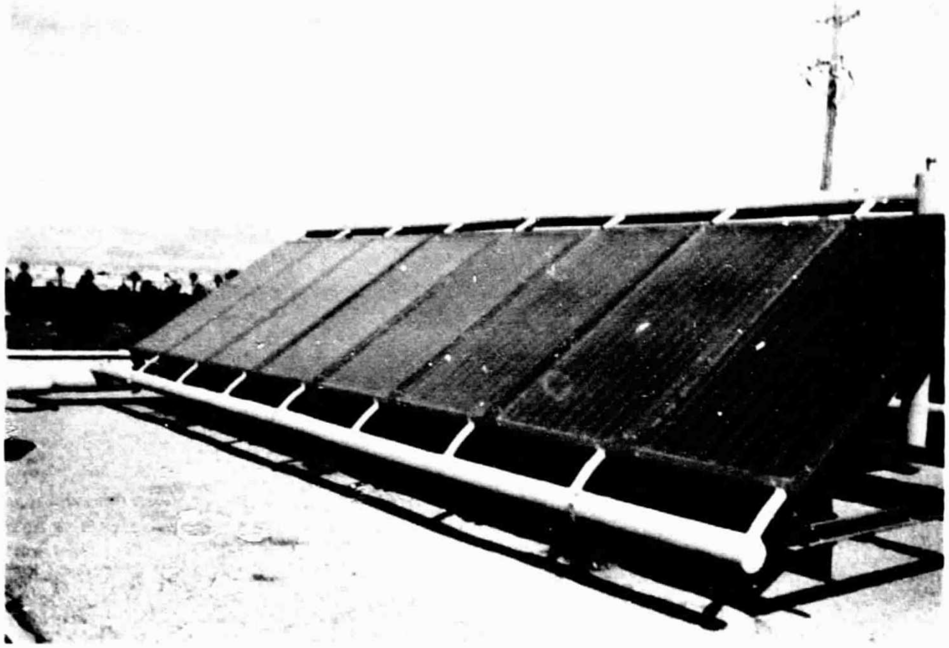
IV. OPERATION OF THE SYSTEM

The system was put into operation in the summer of 1979. During the high temperature and pressure test of the system, 18 collectors developed leaks at solder joints at the waterway and internal header. After investigation, the manufacturer replaced all absorbers in the system. The system has been operating satisfactorily since then.

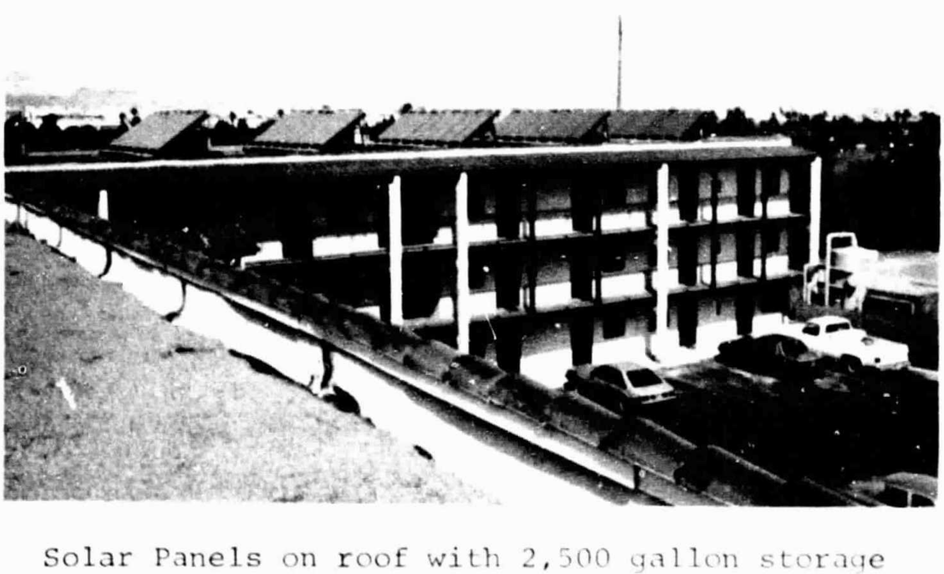
V. PROBLEMS ENCOUNTERED AND SOLUTIONS

The system has been operating without any trouble since its completion. At the time of final inspection, it was noted that some modifications can be made which would improve the efficiency of the system. (Please see attached report in APPENDIX D - VERIFICATION.)

VI. <u>PICTURES OF FINAL INSTALLATION</u>



Solar Panels



Solar Panels on roof with 2,500 gallon storage tank on ground.

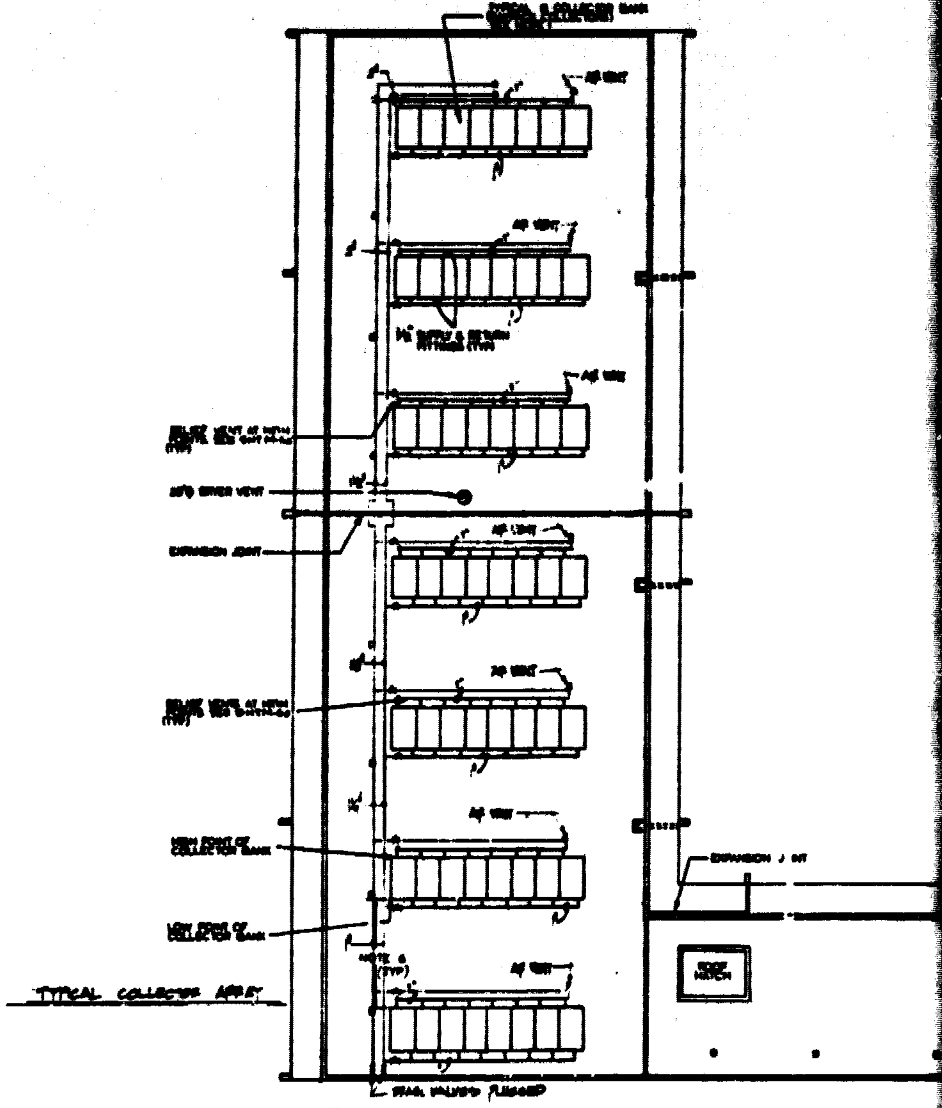
APPENDIX A

ROOF PLAN/SOLAR

FOR

LA QUINTA MOTOR INNS, INC.

LAS VEGAS, NEVADA



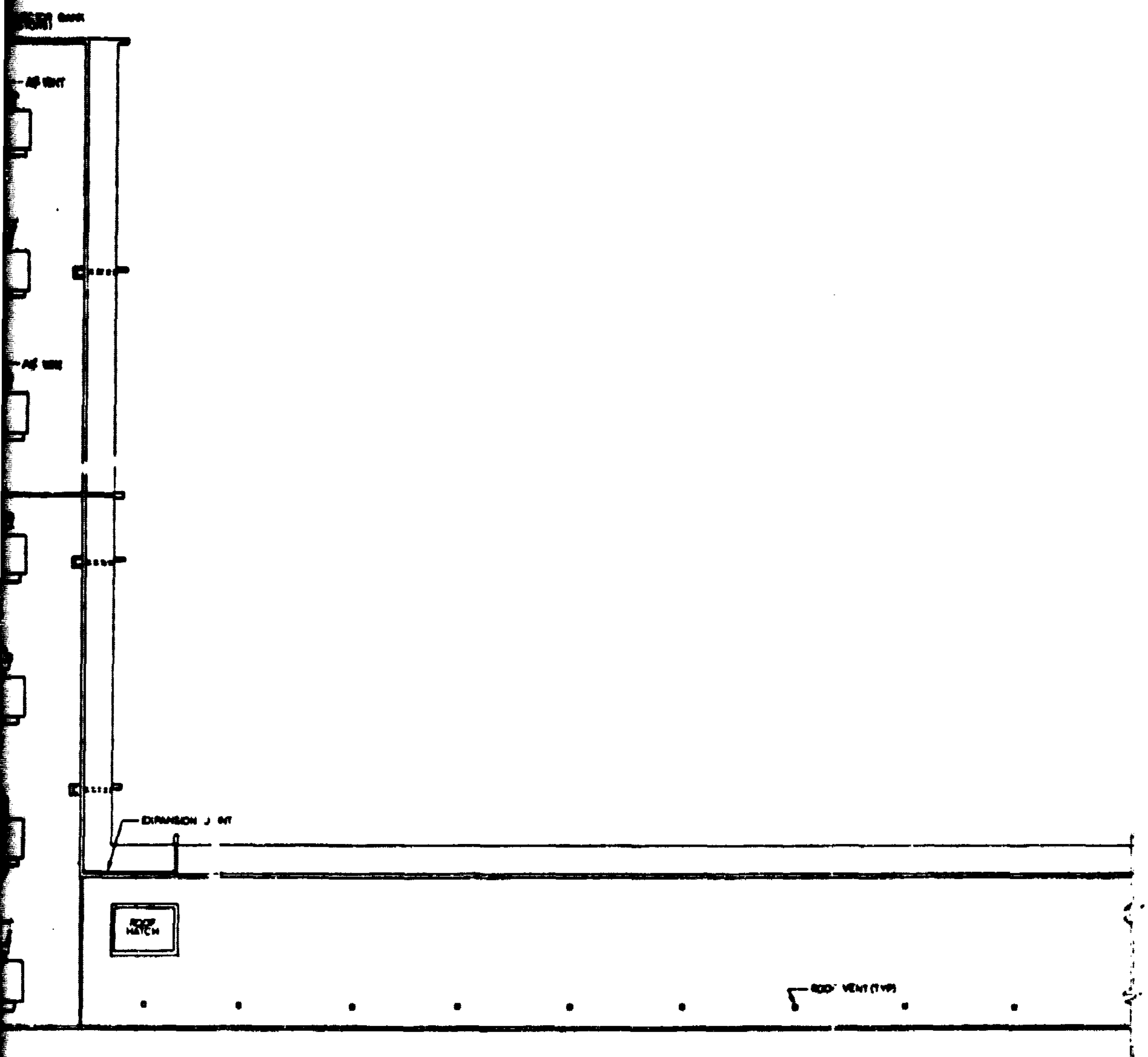
COLLECTOR/PARTIAL ROOF PLAN
SCALE 3/32 = 1-0

FOLDOUT FRAME

REVISION	DATE	DESCRIPTION
6		
5		
4		
3		
2		
1	[illegible]	[illegible]

TRAVIS · BRAUN
& ASSOC. INC.
PLANNERS · ENGINEERS
4100 OFFICE PARKWAY
DALLAS, TEXAS 75204
214 · 821 · 4431

ICO SYS
ARCHITECTS · SYS
251 NEWBURY ST
BOSTON, MASS.
617 · 267 · 6270



TIAL ROOF PLAN

NOTES

1. COLLECTOR INFORMATION

   RAYPACK COLLECTORS
   TILT ANGLE 48°
   GROSS AREA 1200 SQ FT
   NET AREA [illegible] SQ FT
   NO OF COLLECTORS [illegible]

2. ANTIFREEZE SOLUTION [illegible]% PRESTONE II
3. 8 GALLONS PER COLLECTOR - [illegible] GALLONS TOTAL
4. COLLECTORS, MOUNTING BRACKETS BY [illegible]
5. FINAL COLLECTOR CONNECTION TO BE DONE WITH ½ DUCTILE COPPER TUBING
6. REFER TO ARCH ROOF PLAN FOR LOCATION OF MOUNTING CURBS AND COLLECTOR SPACING.

FOLDOUT FRAME 2

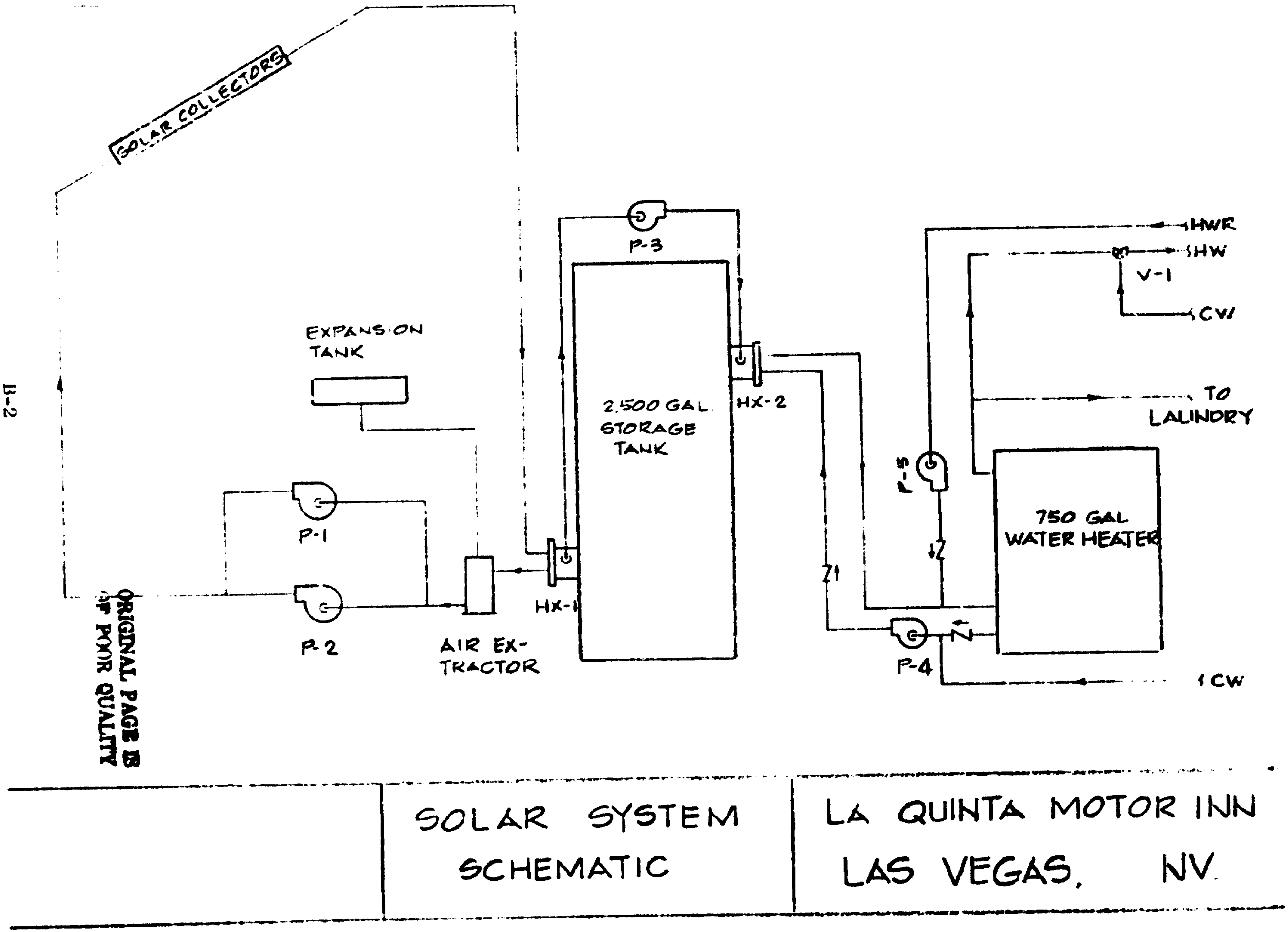
BRAUN NEERS ARKWAY 78284	ICO SYSTEMS INC. ARCHITECTS STRUCT'L ENGINEERS 251 NEWBURY STREET BOSTON, MASS. 02116 617 · 267 · 6270	LQ MOTOR INNS INC. EXECUTIVE OFFICE 66 N.E.LOOP 410, P.O.BOX 32064 SAN ANTONIO, TEXAS 78216 512 349 1221	La Quinta MOTOR INN LAS VEGAS, NEVADA PROPERTY NO COLLECTOR/ROOF PLAN		DATE 8·9·78 SCALE AS SHOWN SHEET M-5s OF 7

APPENDIX B

OPERATOR'S INSTRUCTIONS

AND

MAINTENANCE MANUAL



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I

GENERAL DISCUSSION

This is a closed solar system utilizing two heat exchangers to transfer heat from the solar collectors to the domestic hot water system. Please refer to attached schematic drawing of the solar system.

P-1 and P-2 are solar loop pumps that circulate a 50 - 50 solution of ethylene glycol and water between the solar collectors and the heat exchanger, HX-1. Only one solar loop pump is needed for the system operation, the other solar loop pump serves as 100% standby. The solar loop pumps are controlled by a temperature differential controller which starts the pump when the temperature at the solar collectors is 20°F higher than the temperature in the 2,500 gallon storage tank. The temperature differential controller will deactivate the solar loop pump when the temperature at the solar collectors is not more than 3°F higher than the temperature in the 2,500 gallon storage tank. An alternator alternates the operation of P-1 and P-2 for equal usage.

P-3 is a recirculating pump to improve the heat transfer between the heat exchangers and the stored water in the 2,500 gallon storage tank. P-3 is interlocked with P-1 and P-2 so that if either P-1 or P-2 is activated, so will P-3. In addition, P-3 will activate when the ambient temperature is 32°F or lower.

Domestic cold water will enter heat exchanger, HX-2, to be preheated before entering the 750 gallon water heater. When the temperature in the 2,500 gallon storage tank reached a minimum of 8°F higher than the temperature of the water in the 750 gallon water heater, the temperature differential controller will activate pump P-4 to transfer the heat from the 2,500 gallon storage tank to the 750 gallon water heater. Pump P-4 will be de-activated when the temperature in the 2,500 gallon storage tank is only 4°F higher than the temperature of the 750 gallon water heater.

P-5 is the usual hot water recirculating pump of the buildings hot water system.

Mixing valve, V-1 is set to prevent the temperature of the hot water supplied to the building from exceeding 140°F.

II

MAINTENANCE REQUIREMENTS

1. **Once a Week:**

   a. Check fluid level in the solar system expansion tank. If low, add a 50 - 50 mixture of ethylene glycol and water to the system. CAUTION: NEVER ADD PLAIN WATER TO THE SYSTEM.

2. Once a Month:

   a. Wash glass surfaces of the solar collectors using a mild detergent solution and a soft brush. Thoroughly rinse with clean water.

   b. Check temperature differential controllers and alternator for proper operation.

   c. Check for fluid leaks from collectors and piping.

3. Once a Year:

   a. Check pump seals for leakage.

   b. Draw a sample of heat transfer fluid from the solar system for analysis and determination of any action needed to provide maximum corrosion inhibition.

APPENDIX C

MANUFACTURER'S LITERATURE

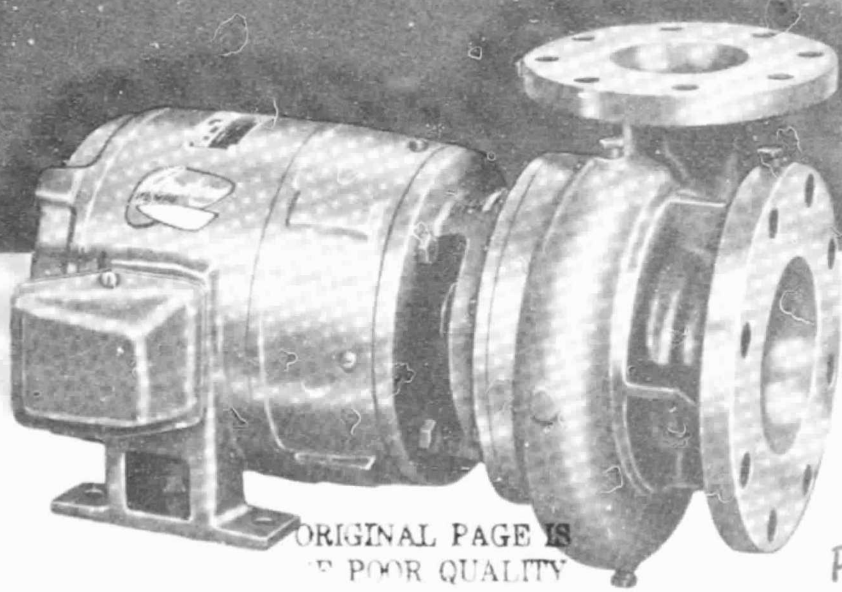
ARMSTRONG

NOTE PAGES 10 & 12

FILE NO.	5042.00
DATE:	JUNE 30, 1971
SUPERSEDES:	5042.00
DATE:	JAN. 31, 1968

MOTOR MOUNT
Centrifugal Pumps

SERIES 4260 for small capacities
SERIES 4280 single mechanical seal
SERIES 4285 packing gland arrangement
SERIES 4290 double mechanical seal



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P-1 & P-2

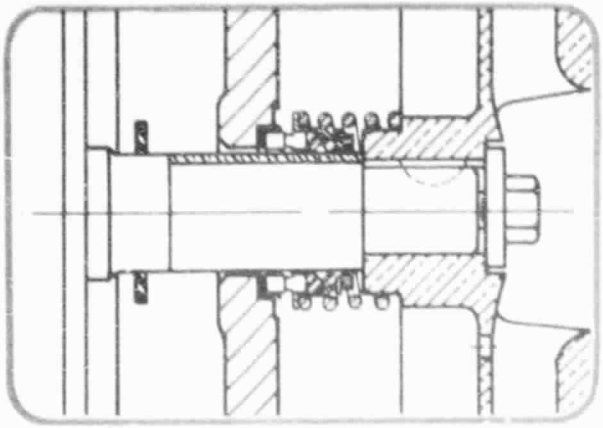
ARMSTRONG PRODUCTS
HALLMARK OF QUALITY

ARMSTRONG PUMPS INC.

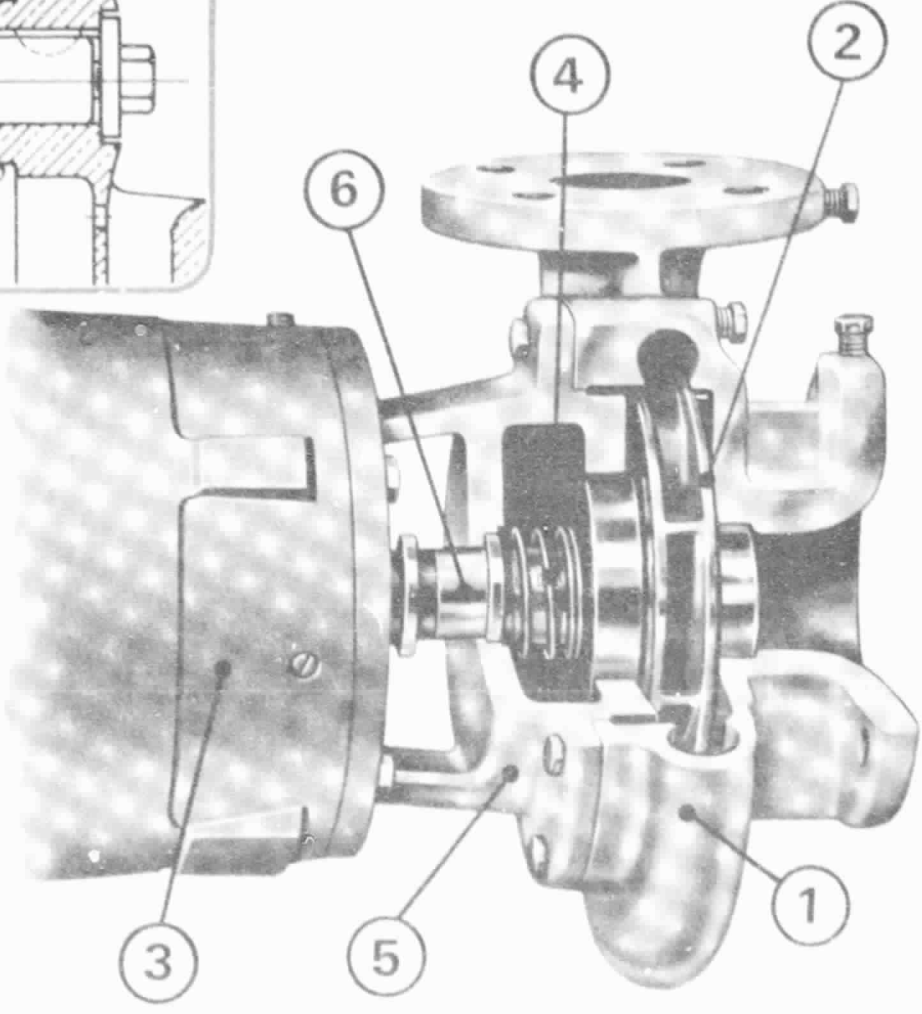
NORTH TONAWANDA, N.Y.

ARMSTRONG MOTOR MOUNT CENTRIFUGAL PUMPS

The motor-mount concept of pump design has a number of inherent advantages . . . compact arrangement, ease of installation, elimination of alignment problems and simplification of foundations. In addition, Armstrong Series 4260, 4280, 4285 and 4290 pumps offer an extensive range of outputs, optional materials of construction and a choice of important design features . . . a comprehensive, integrated line with wide acceptance for a variety of applications.



SERIES 4280



- EXTENSIVE INTERCHANGE-ABILITY OF PARTS
- MANUFACTURED AND INSPECTED TO RIGID STANDARDS
- ALL PUMPS FACTORY TESTED PRIOR TO SHIPPING

1 VOLUTE. Radially-split volute can be left in the line while servicing the pump, eliminating needless disconnecting of pipes. Tapped openings are provided for venting, draining and gauge connections. Wearing Rings optional.

2 IMPELLER. Balancing chamber and pressure relief holes in the impeller reduce axial thrusts to a minimum, ensuring smooth performance and long life.

3 MOTOR. The motor is equipped with heavy duty grease-lubricated ball bearings adequately rated to accommodate impeller radial loads and residual hydraulic thrusts.

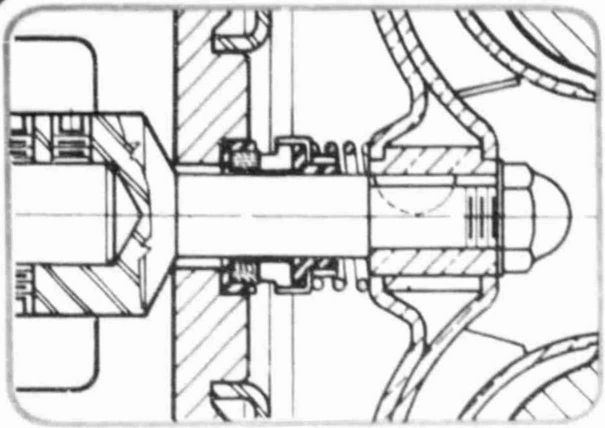
4 MECHANICAL SEAL. Self-lubricating "ARMSEAL" prevents liquid seepage. A carbon face rotating against a stationary ceramic seat provides positive sealing up to full design pressure.

5 BRACKET. A heavy cylindrical bracket with 360-degree register on both flanges provides a rigid union of pump and motor . . . and establishes perfect alignment.

6 SHAFT. The impeller is mounted on an extension of the motor shaft with minimum overhang. A suitable shaft sleeve affords protection in the wetted area.

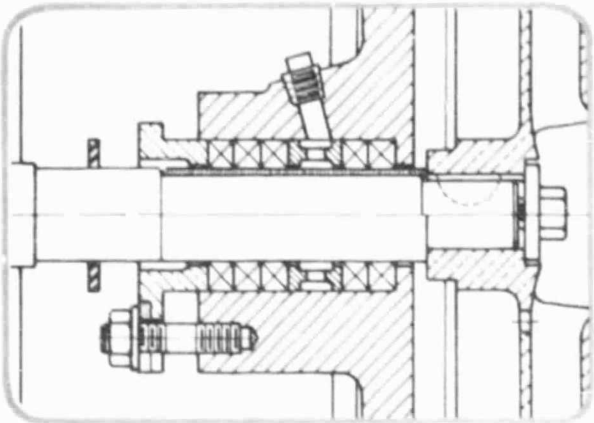
- BACK PULL-OUT DESIGN. This feature eliminates the need to break piping connections when servicing the pump. The motor, with bracket and impeller attached, can be easily withdrawn from the volute after removing the volute capscrews.

ARMSTRONG MOTOR MOUNT CENTRIFUGAL PUMPS



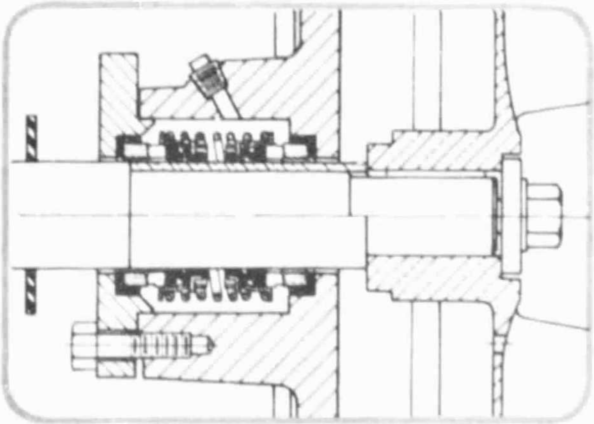
SERIES 4260

Small capacity pump with mechanical seal. Stub shaft arrangement permits the use of standard "C" flange motors.



SERIES 4285

Packing gland arrangement . . . for use when pumping contaminated liquids and/or higher temperatures where gland leakage can be tolerated. Stuffing box can be lubricated either by liquid pumped or by separate clean water supply.

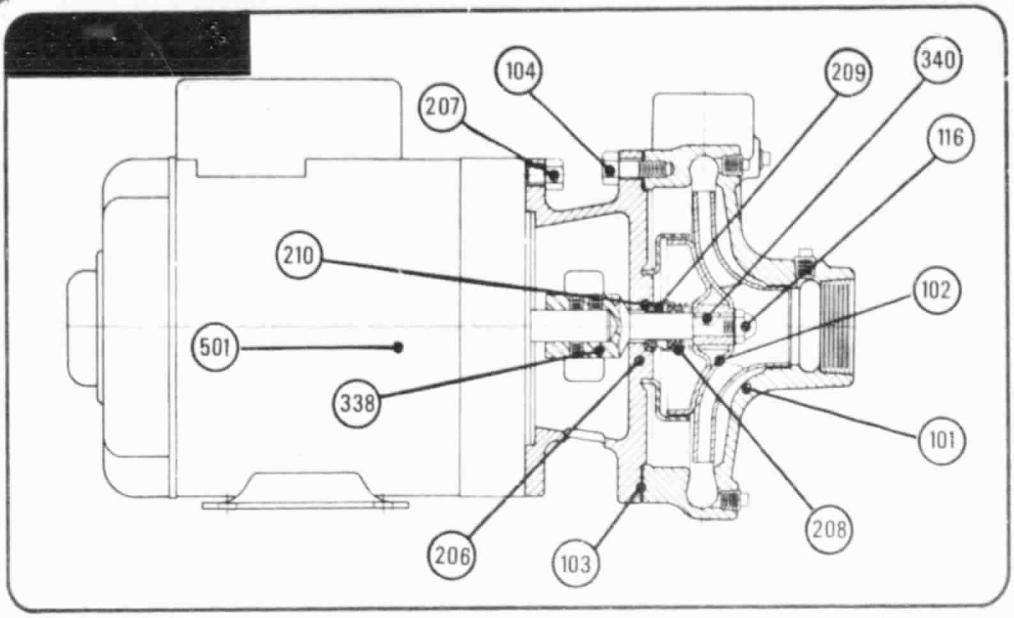


SERIES 4290

Double mechanical seal arrangement . . . for use when pumping contaminated liquids and/or higher temperatures without loss of system liquid. Sealing water can be taken from pump discharge . . . through a heat exchanger if necessary . . . or from city supply mains. Raw sealing water does not enter system.

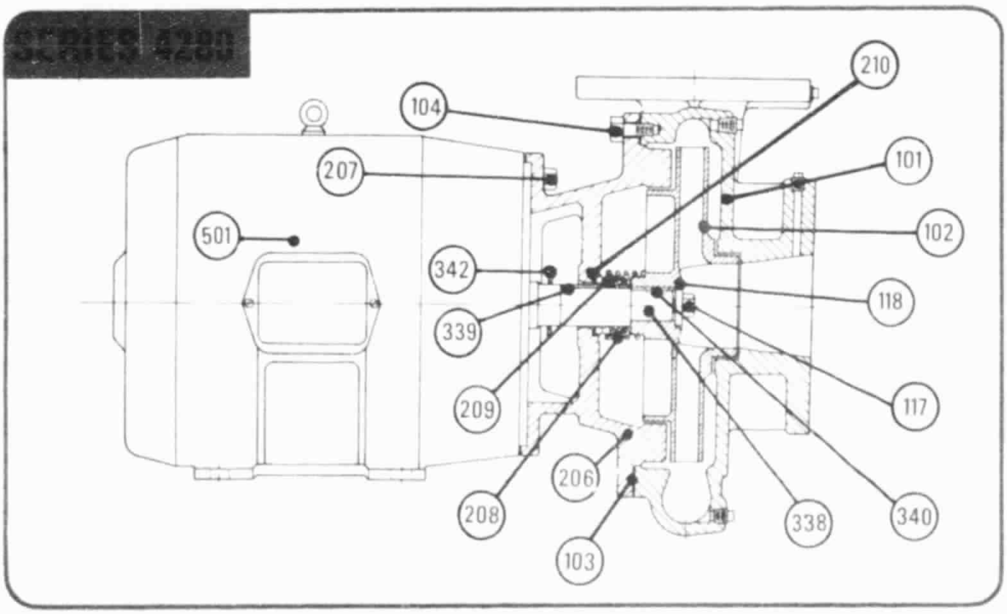
DESIGN DATA	SERIES 4260	SERIES 4280	SERIES 4285	SERIES 4290
Pump sizes	¾" through 1½"	1¼" through 6"	1¼" through 6"	1¼" through 6"
Capacity range	10 to 130 USGPM	10 to 1500 USGPM	10 to 1500 USGPM	10 to 1500 USGPM
Head range	up to 110 feet	up to 440 feet	up to 440 feet	up to 440 feet
Maximum working pressure	175 psig	175 psig	175 psig	175 psig
Hydrostatic test pressure	265 psig	265 psig	265 psig	265 psig
Maximum pumping temperature	225°F.	225°F.	250°F	subject to specific operating conditions

ARMSTRONG MOTOR MOUNT CENTRIFUGAL PUMPS



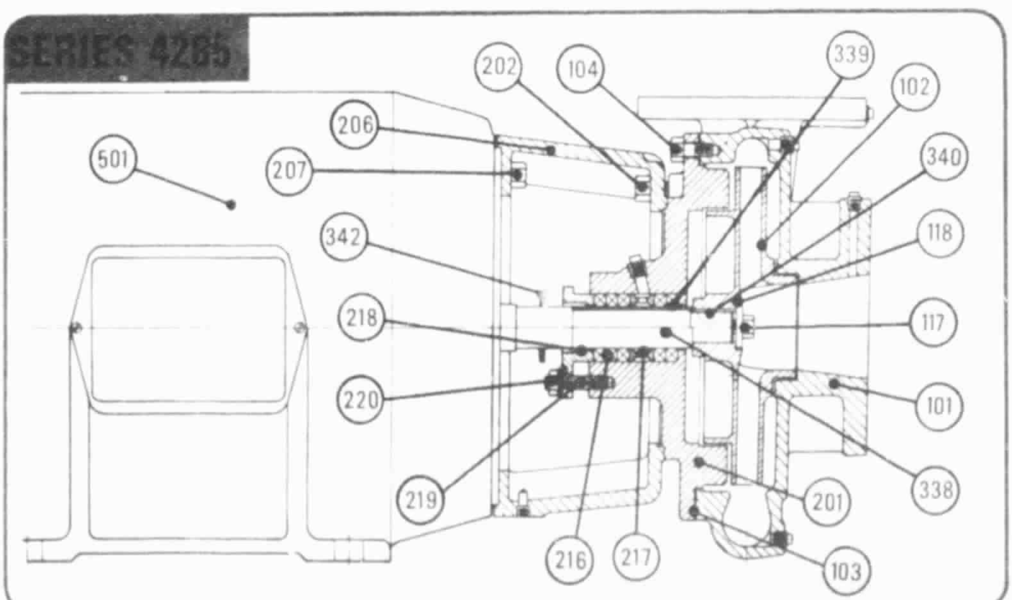
SERIES 4260

101 Volute
102 Impeller
103 Volute gasket
104 Volute capscrew
116 Impeller nut
206 Motor/pump bracket
207 Motor capscrew
208 Mechanical seal
209 Seat insert
210 Seat insert gasket
338 Shaft
340 Impeller key
501 Motor



SERIES 4280

101 Volute
102 Impeller
103 Volute gasket
104 Volute capscrew
117 Impeller capscrew
118 Impeller washer
206 Motor/pump bracket
207 Motor capscrew
208 Mechanical seal
209 Seat insert
210 Seat insert gasket
338 Shaft
339 Shaft sleeve
340 Impeller key
342 Water slinger
501 Motor



SERIES 4285

101 Volute
102 Impeller
103 Volute gasket
104 Volute capscrew
117 Impeller capscrew
118 Impeller washer
201 Coverplate
202 Coverplate capscrew
206 Motor/pump bracket
207 Motor capscrew
216 Gland packing
217 Lantern ring
218 Gland plate
219 Gland stud
220 Gland nut
338 Shaft
339 Shaft sleeve
340 Impeller key
342 Water slinger
501 Motor

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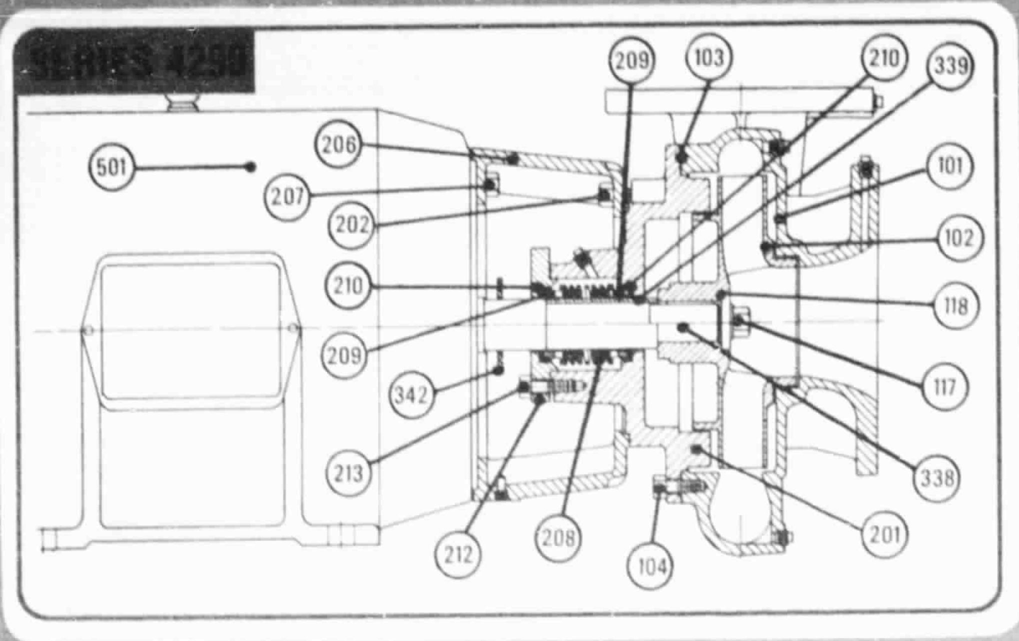
ARMSTRONG MOTOR MOUNT CENTRIFUGAL PUMPS



SERIES 4290

- 101 Volute
- 102 Impeller
- 103 Volute gasket
- 104 Volute capscrew
- 117 Impeller capscrew
- 118 Impeller washer
- 201 Coverplate
- 202 Coverplate capscrew
- 206 Motor/pump bracket
- 207 Motor capscrew
- 208 Mechanical seal
- 209 Seat insert
- 210 Seat insert gasket
- 212 Seal plate
- 213 Seal plate capscrew
- 338 Shaft
- 339 Shaft sleeve
- 342 Water slinger
- 501 Motor

MATERIALS OF CONSTRUCTION

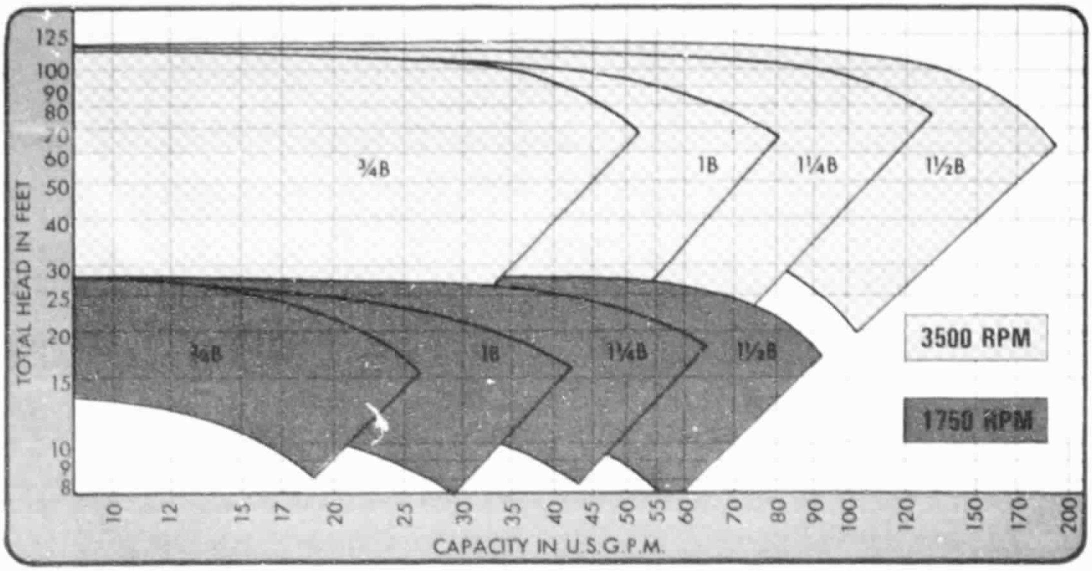
PUMP TYPE	PART NAME	BRONZE-FITTED PUMP	ALL-IRON PUMP	ALL-BRONZE PUMP
SERIES 4260	Volute	Cast Iron	Cast Iron	Bronze
	Volute Capscrew	Steel	Steel	Bronze
	Impeller	Bronze	Plated Steel	Bronze
	Mechanical Seal	Brass Fitted	Steel Fitted	Brass Fitted
	Stub Shaft	Stainless Steel	Stainless Steel	Stainless Steel
	Motor/Pump Bracket	Cast Iron	Cast Iron	Cast Iron with Bronze Faceplate
SERIES 4280 SERIES 4285 SERIES 4290	Volute	Cast Iron	Cast Iron	Bronze
	Volute Capscrew	Steel	Steel	Bronze
	Impeller	Bronze	Cast Iron	Bronze
	Motor/Pump Bracket	Cast Iron	Cast Iron	Bronze
SERIES 4280	Mechanical Seal	Brass Fitted	Steel Fitted	Brass Fitted
	Seat Insert	Ceramic	Ceramic	Ceramic
	Insert Gasket	Synthetic Rubber	Synthetic Rubber	Synthetic Rubber
	Shaft Sleeve	Bronze	Plated Steel	Bronze
SERIES 4285	Gland	Bronze	Cast Iron	Bronze
	Gland Packing	Graphited Asbestos	Graphited Asbestos	Graphited Asbestos
	Lantern Ring	Bronze	Cast Iron	Bronze
	Shaft Sleeve	Bronze	Stainless Steel	Bronze
SERIES 4290	Mechanical Seal	Brass Fitted	Steel Fitted	Brass Fitted
	Seat Insert	Ceramic	Ceramic	Ceramic
	Insert Gasket	Synthetic Rubber	Synthetic Rubber	Synthetic Rubber
	Shaft Sleeve	Bronze	Stainless Steel	Bronze

ARMSTRONG MOTOR MOUNT CENTRIFUGAL PUMPS

COMPOSITE CHARTS

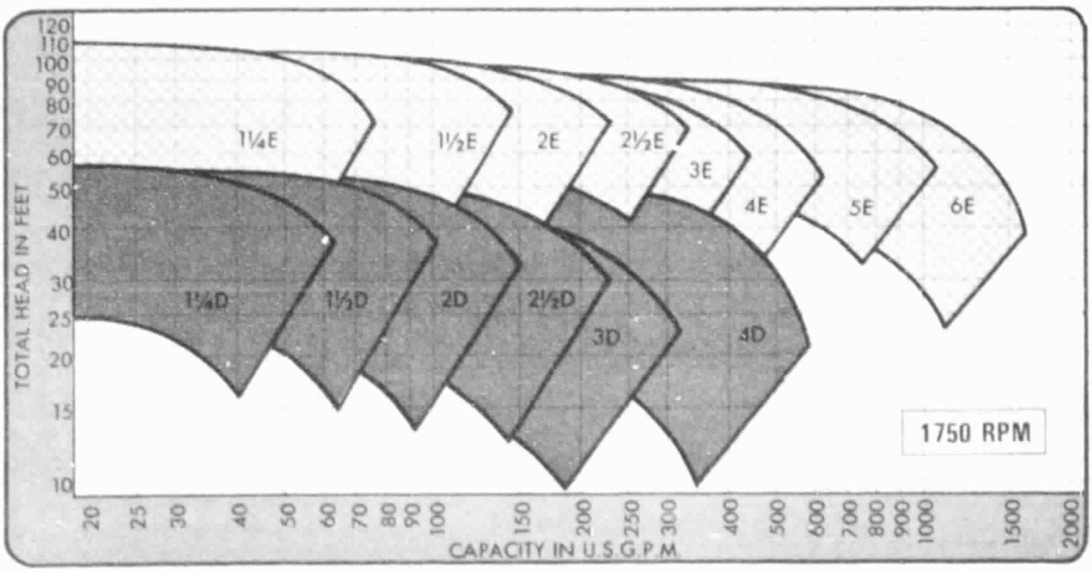
SERIES 4260

1750 & 3500 RPM



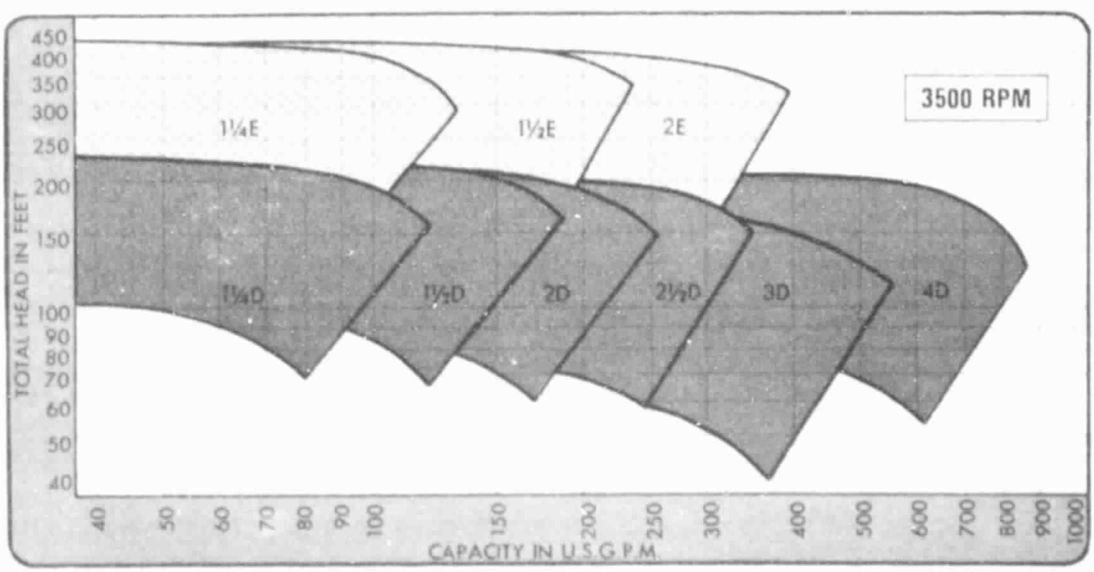
SERIES 4280 4285 & 4290

1750 RPM



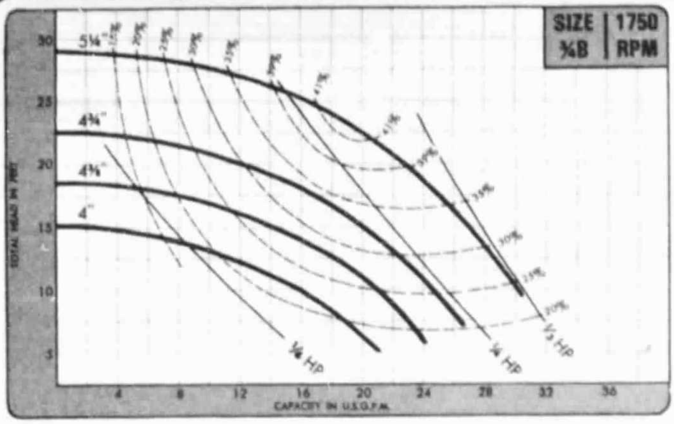
SERIES 4280 4285 & 4290

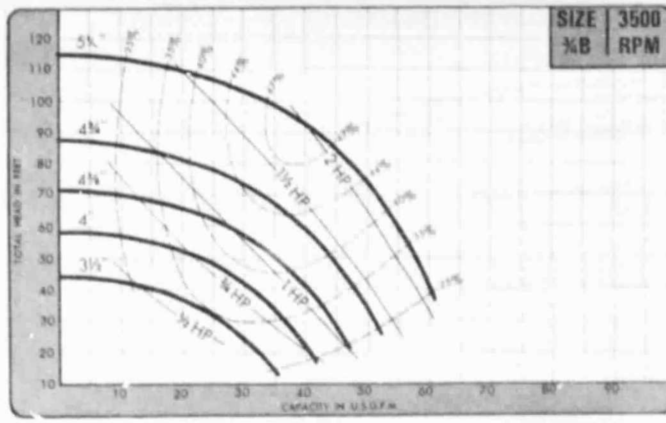
3500 RPM

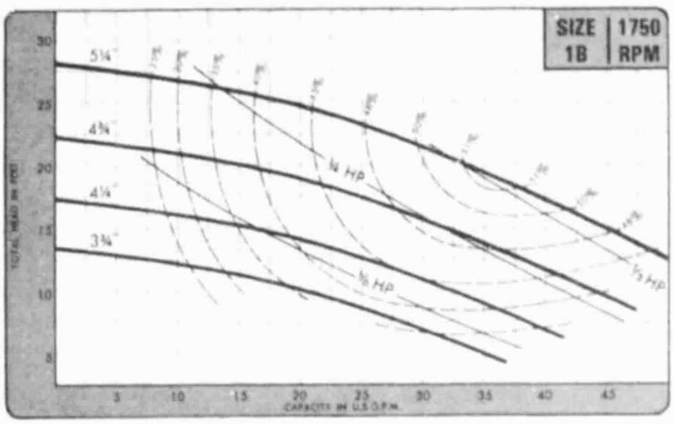


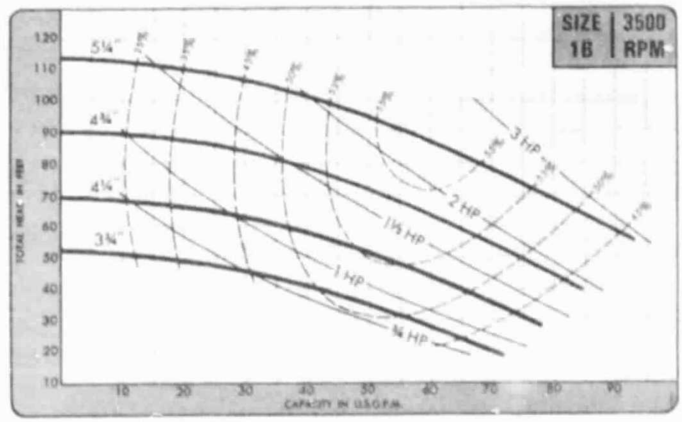
ARMSTRONG MOTOR MOUNT CENTRIFUGAL PUMPS

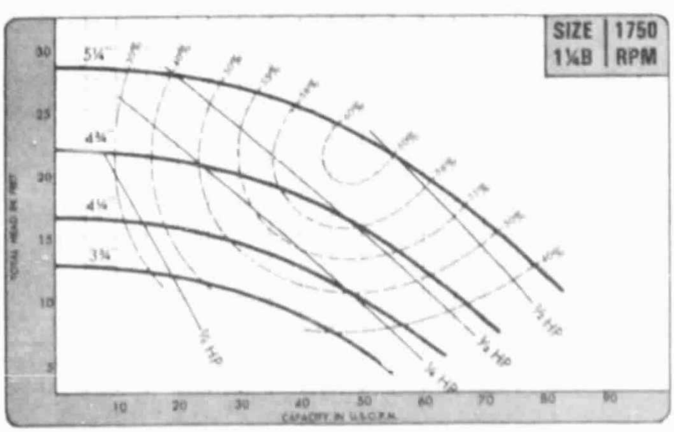
PERFORMANCE CURVES SERIES 4260

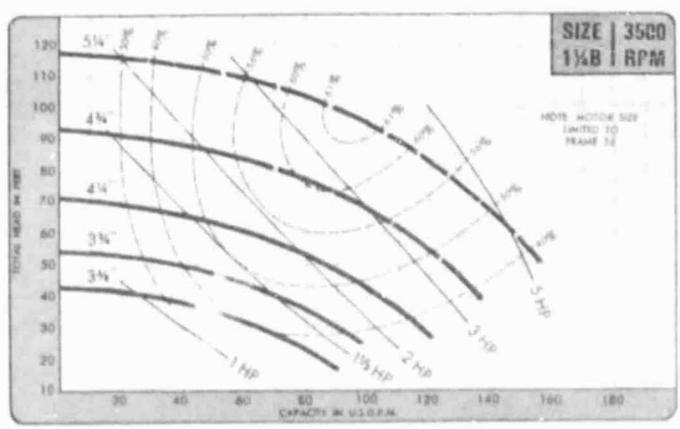


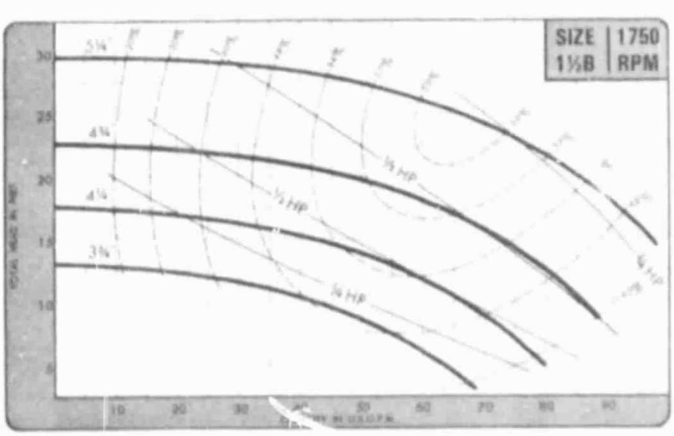


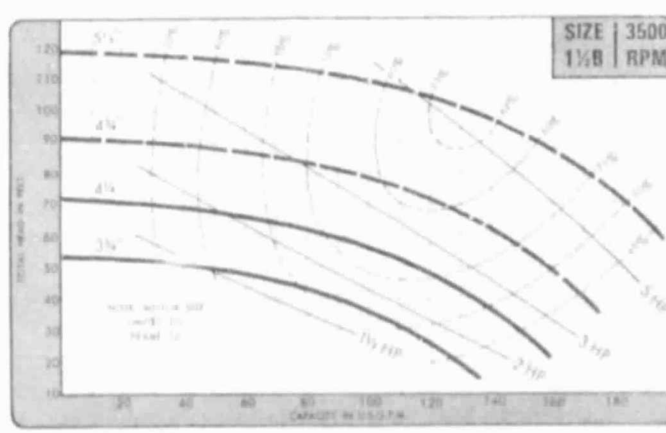








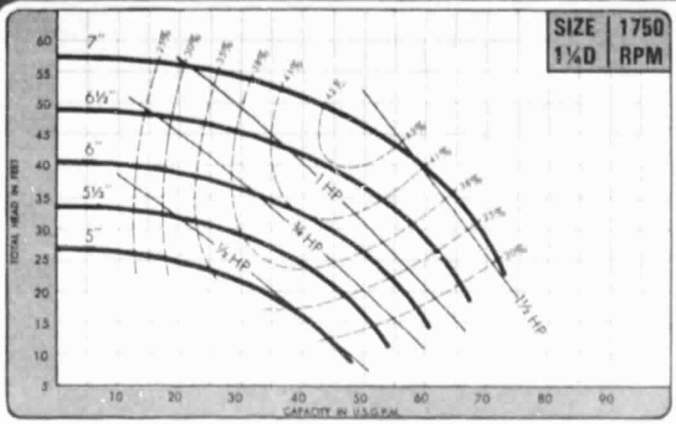


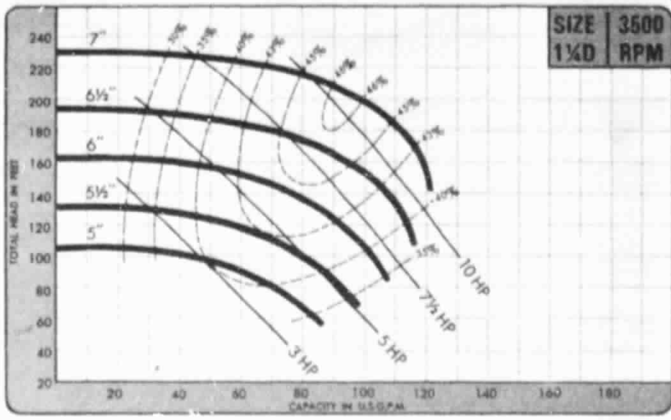


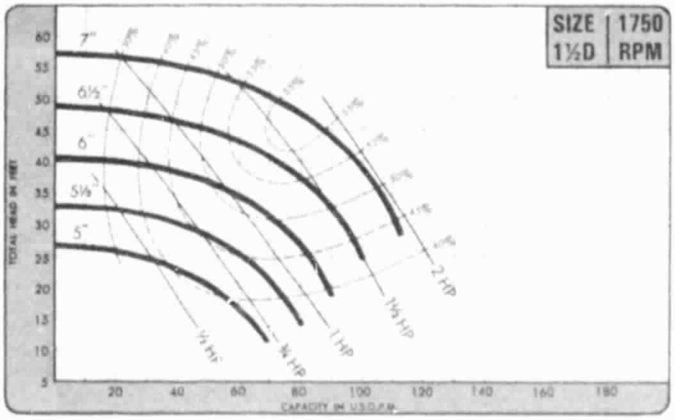
ARMSTRONG MOTOR MOUNT CENTRIFUGAL PUMPS

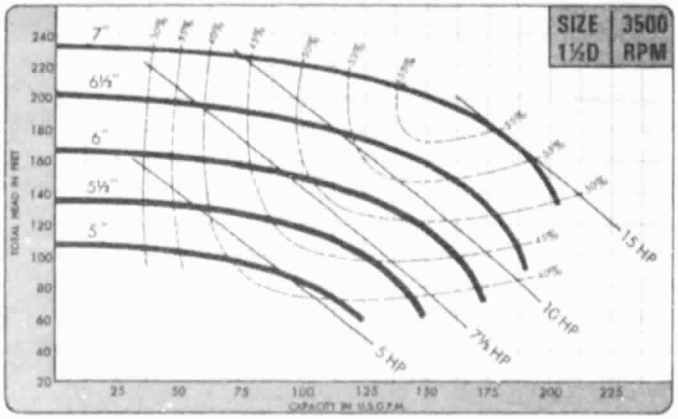
PERFORMANCE CURVES

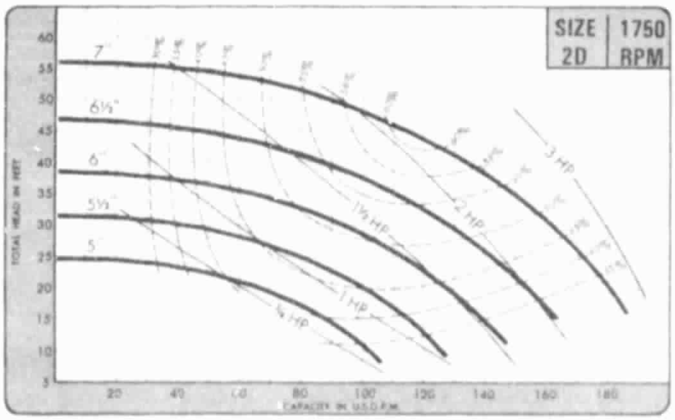
SERIES 4280
SERIES 4285
SERIES 4290

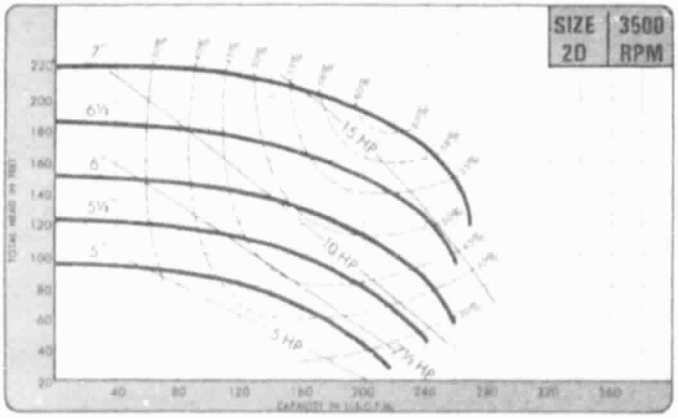


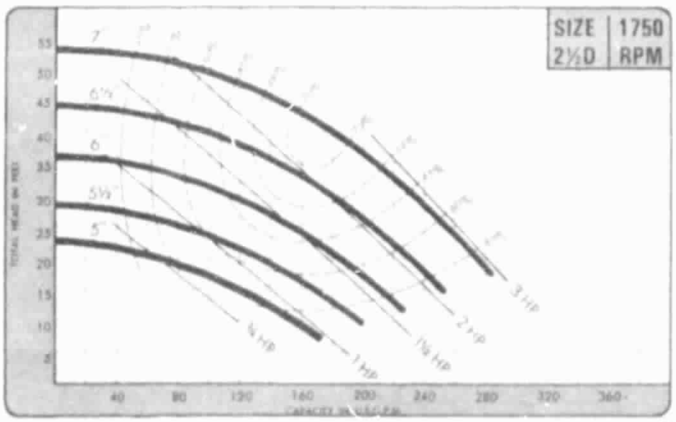


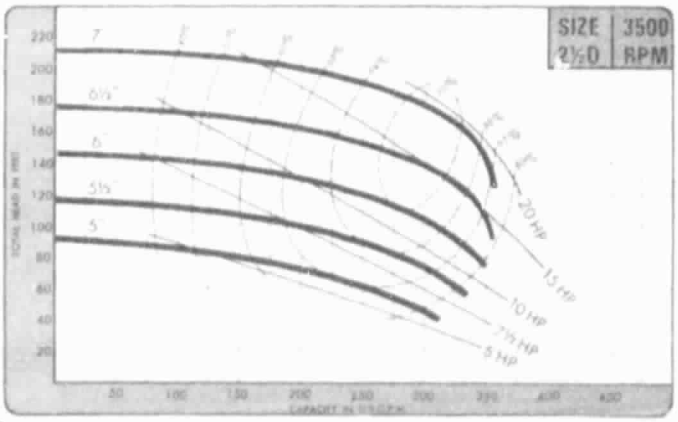












ARMSTRONG MOTOR MOUNT CENTRIFUGAL PUMPS

PERFORMANCE CURVES

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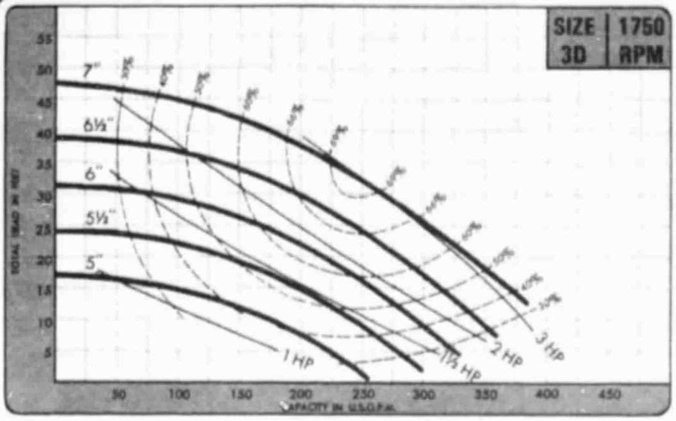
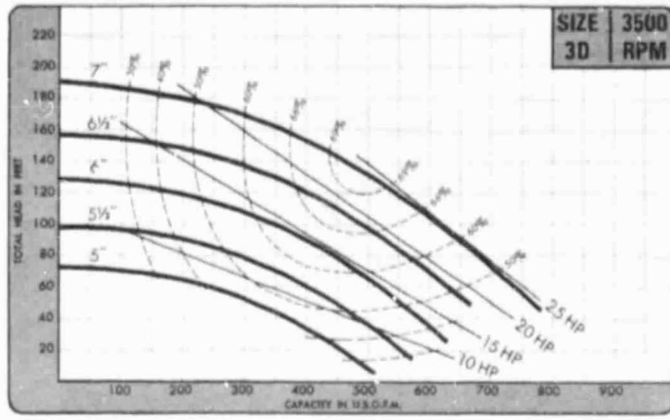
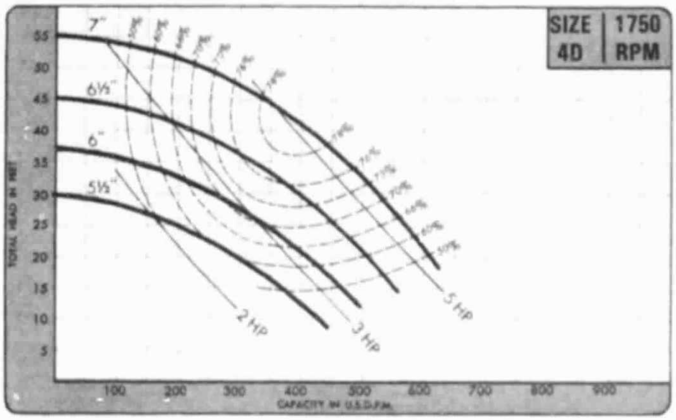
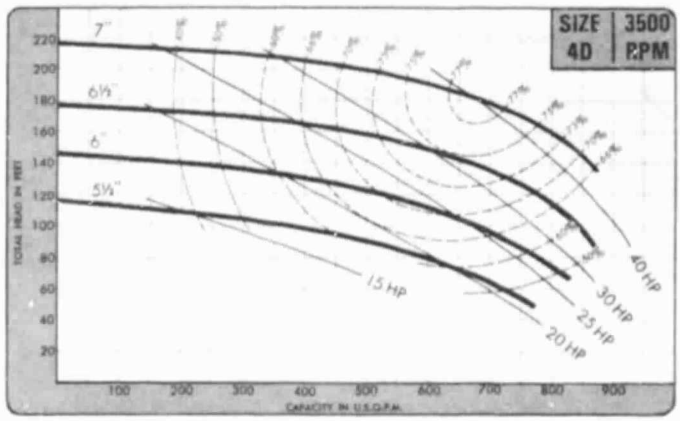
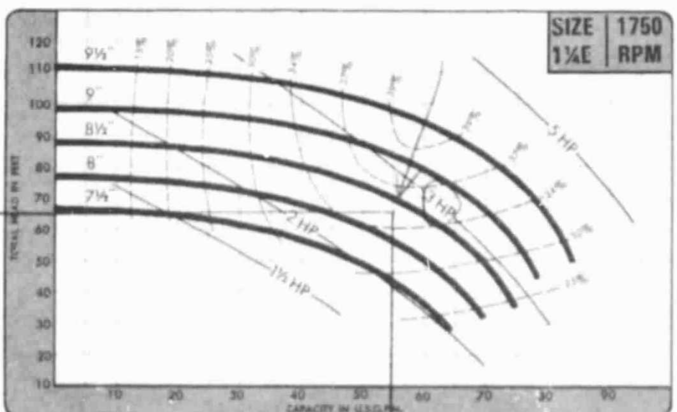
SERIES 4285
SERIES 4290

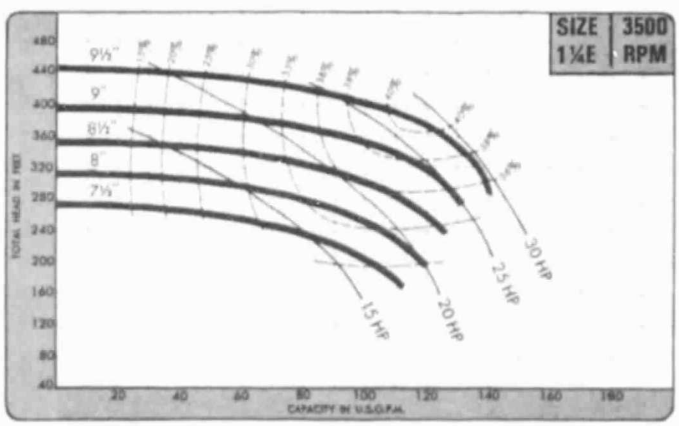


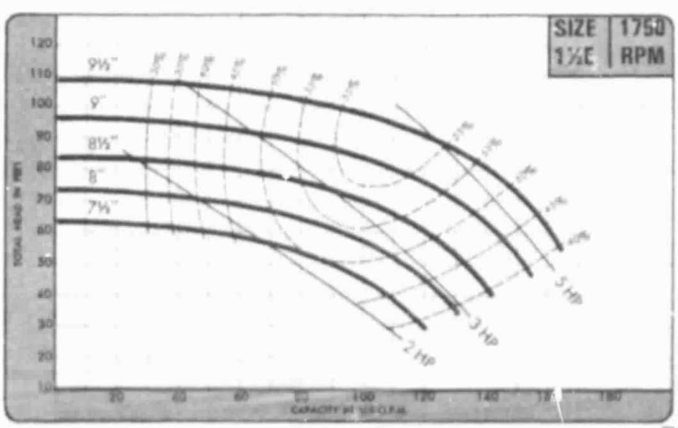


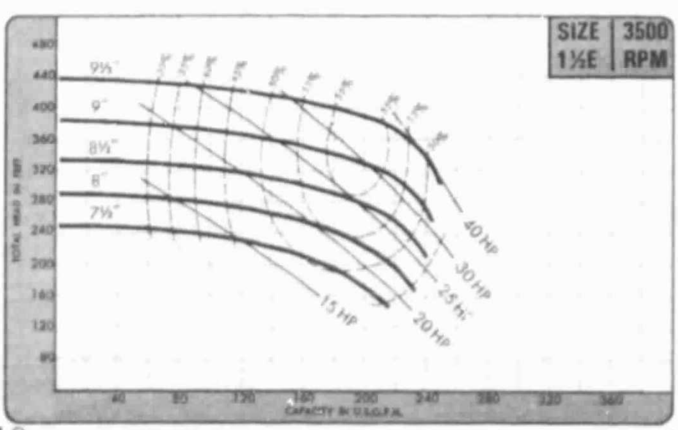






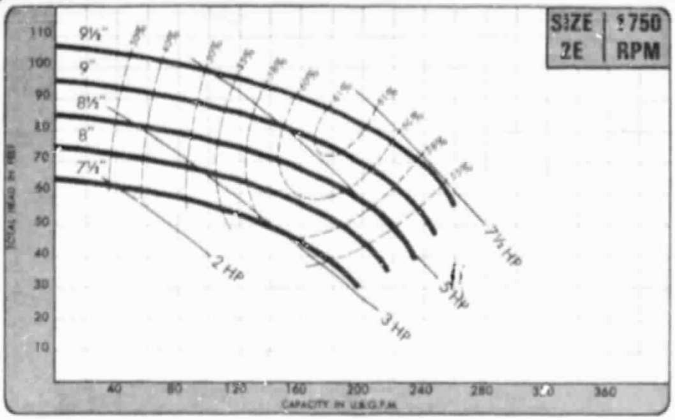


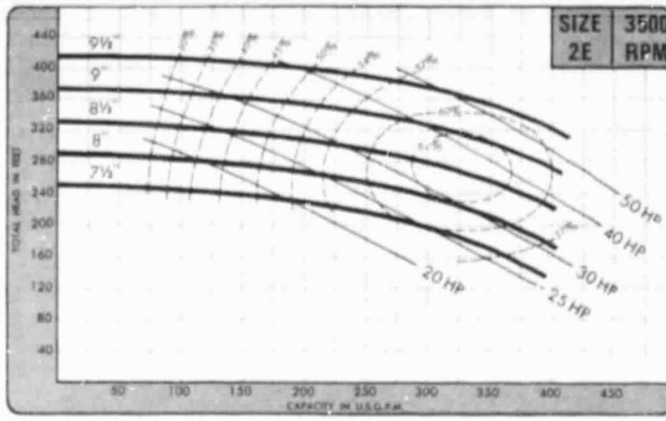


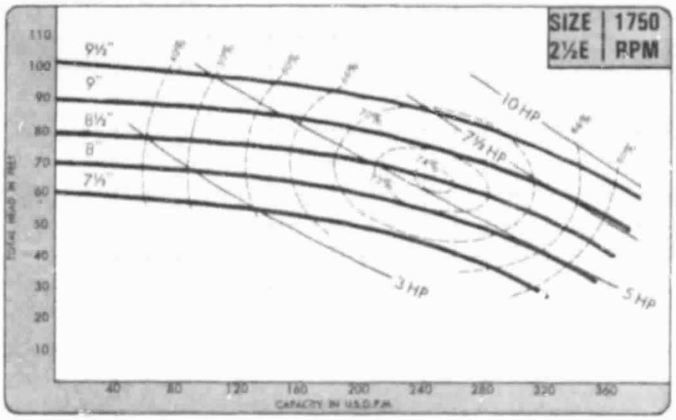


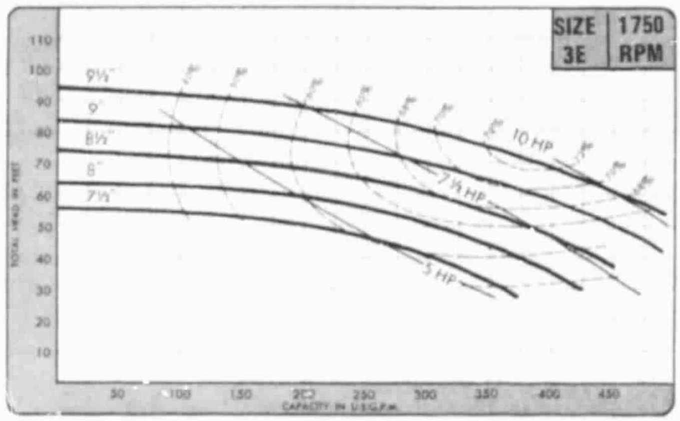
PERFORMANCE CURVES

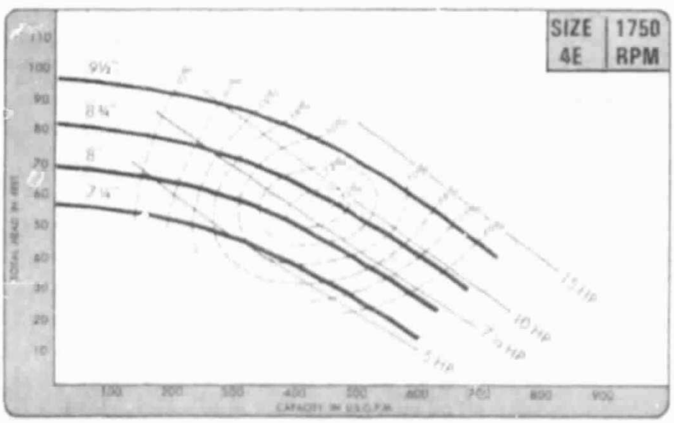
SERIES 4280
SERIES 4285
SERIES 4290

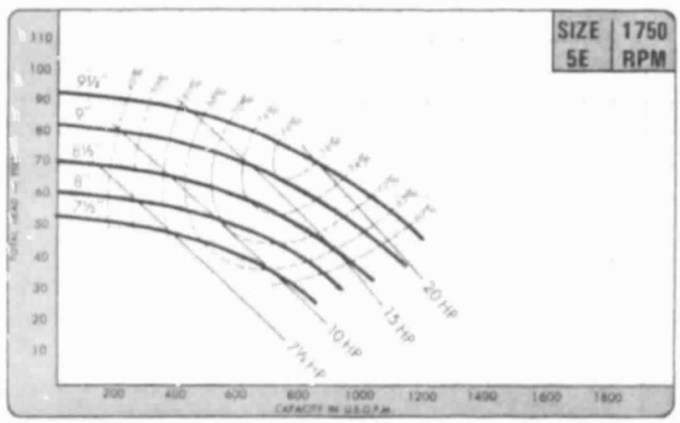


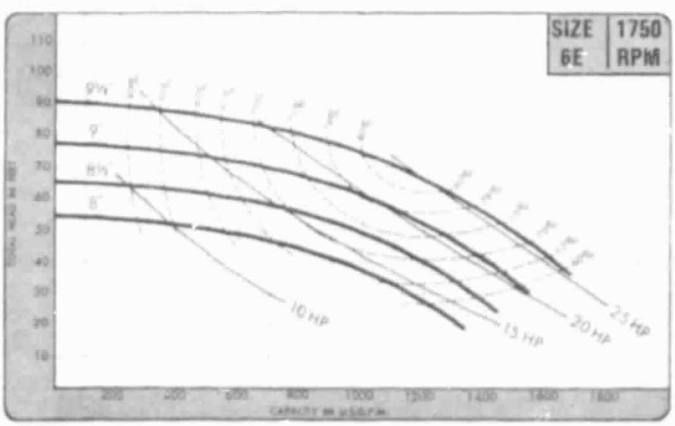






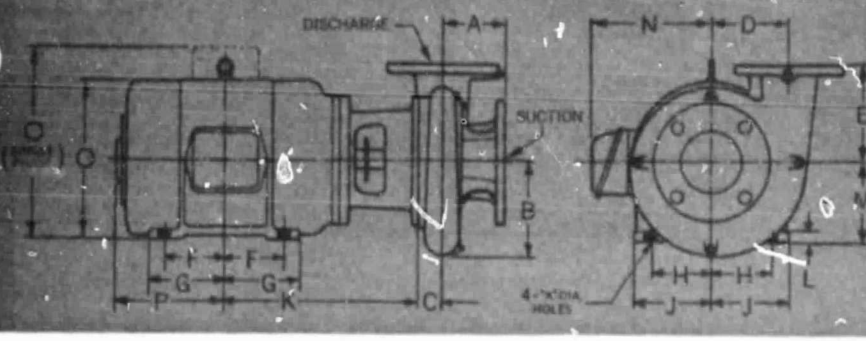






ALL PERFORMANCE CURVES ARE BASED ON PUMPING CLEAN COLD FRESH WATER AT A TEMPERATURE NOT EXCEEDING 85°F (SPECIFIC GRAVITY 1·0).

ARMSTRONG MOTOR MOUNT CENTRIFUGAL PUMPS



DIMENSIONAL DATA

SERIES 4280
SERIES 4285
SERIES 4290

PUMP

ALL DIMENSIONS IN INCHES*

PUMP SIZE	BRANCH SIZE DISCHARGE	BRANCH SIZE SUCTION	BRANCH TYPE	A	B	C	D	E
1 1/4D	1 1/4	1 1/2	Screwed	2 7/8	4 13/16	1 5/16	4 1/2	5
1 1/4E	1 1/4	1 1/2	Screwed	2 13/16	5 3/8	1 7/16	5 1/2	8
1 1/2D	1 1/2	2	Screwed	3 1/8	5	1 7/16	4 5/8	6
1 1/2E	1 1/2	2	Screwed	3 1/8	6 1/4	1 7/16	5 3/4	6 1/2
2D	2	2 1/2	Flanged	3	5 5/16	1 7/16	4 3/4	6 1/2
2E	2	2 1/2	Flanged	3 7/16	6 5/8	1 9/16	5 7/8	7
2 1/2D	2 1/2	3	Flanged	3 5/8	5 1/2	1 1/2	4 11/16	6

PUMP SIZE	BRANCH SIZE DISCHARGE	BRANCH SIZE SUCTION	BRANCH TYPE	A	B	C	D	E
2 1/2E	2 1/2	3	Flanged	3 1/2	7	1 9/16	6	6 3/4
3D	3	4	Flanged	4 1/8	6 1/8	1 3/4	5	6
3E	3	4	Flanged	4 3/4	7 1/16	1 7/8	6 1/8	7 1/2
4D	4	5	Flanged	4 3/4	6 1/2	2	5	6 1/4
4E	4	5	Flanged	4 3/4	7 3/4	1 7/8	6 5/8	7 1/2
5E	5	6	Flanged	5 9/16	8 3/4	2 3/8	6 15/16	8 1/4
6E	6	8	Flanged	7	9	2 1/2	7 1/2	11

Pump sizes 2" and larger have 125 lb. standard ASA flanges. Smaller pump sizes have NPT screwed connections. All pumps are rated for 175 psig maximum working pressure.

THREE-PHASE MOTOR

ALL DIMENSIONS IN INCHES*

Motor Frame Size: Series 4280	Motor Frame Size: Series 4285/4290	HP @ 1750 RPM	HP @ 3600 RPM	F	G	H	J	K: Series 4280	K: Series 4285/4290	L	M	X	DRIP-PROOF: N	DRIP-PROOF: O	DRIP-PROOF: P	TEFC: N	TEFC: O	TEFC: P
143JM	143JP	3/4 & 1	1 1/2	2	2 1/2	2 3/4	3 1/2	8 1/16	11 3/8	5/32	3 1/2	11/32	5 3/4	7	4 3/16	5 5/8	7 1/4	5 5/8
145JM	145JP	1 1/2 & 2	2 & 3	2 1/2	3	2 3/4	3 1/2	8 9/16	11 7/8	5/32	3 1/2	11/32	5 3/4	7	4 11/16	5 5/8	7 1/4	6 1/8
182JM	182JP	3	5	2 1/4	2 7/8	3 3/4	4 1/2	9 1/16	12 3/8	7/16	4 1/2	13/32	8 1/8	9	4 15/16	8 1/8	9 3/8	6 1/4
184JM	184JP	5	7 1/2	2 3/4	3 3/8	3 3/4	4 1/2	9 9/16	12 7/8	7/16	4 1/2	13/32	8 1/8	9	5 7/16	8 1/8	9 3/8	7 1/4
213JM	213JP	7 1/2	10	2 3/4	3 1/2	4 1/4	5 1/4	10 5/8	13 3/8	1/2	5 1/4	13/32	8 3/4	10 1/16	6 1/8	9 1/16	11 1/8	8
215JM	215JP	10	15	3 1/2	4 1/4	4 1/4	5 1/4	11 3/8	14 3/8	1/2	5 1/4	13/32	8 3/4	10 9/16	6 7/8	9 1/16	11 5/8	8 5/8
254TCZ	254JP	15	20	4 1/8	5 1/4	5	6 3/8	16 3/8	16	3/4	6 1/4	17/32	9 1/2	12 1/2	8 1/8	10 11/16	13 15/16	10
256TCZ	256JP	20	25	5	6 1/8	5	6 3/8	17 1/8	16 7/8	3/4	6 1/4	17/32	9 1/2	12 1/2	9	10 11/16	13 15/16	10 7/8
284TCZ	284JP	25	30	4 3/4	6 1/8	5 1/2	6 13/16	16 13/16	16 3/8	3/4	7	17/32	11 1/4	14	9 1/4	12 5/8	15	11 13/16
286TCZ	286JP	—	40	5 1/2	6 7/8	5 1/2	6 13/16	17 9/16	17 3/8	3/4	7	17/32	11 1/4	14	10	12 5/8	15	11 13/16

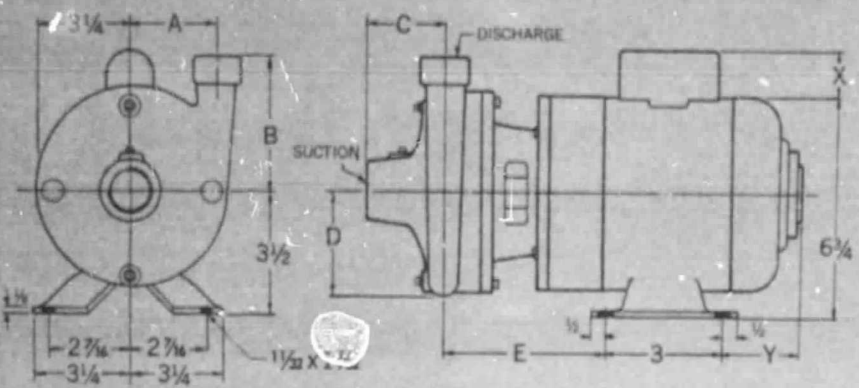
SINGLE-PHASE MOTOR

ALL DIMENSIONS IN INCHES*

Motor Frame Size: Series 4280	Motor Frame Size: Series 4285/4290	HP @ 1750 RPM	HP @ 3600 RPM	F	G	H	J	K: Series 4280	K: Series 4285/4290	L	M	X	DRIP-PROOF: N	DRIP-PROOF: O	DRIP-PROOF: P	TEFC: N	TEFC: O	TEFC: P
143JM	143JP	1	1 1/2	2	2 1/2	2 3/4	3 1/2	8 1/16	11 3/8	5/32	3 1/2	11/32	5 3/4	7	4 3/16	5 5/8	7 1/4	5 5/8
145JM	145JP	1 1/2	2	2 1/2	3	2 3/4	3 1/2	8 9/16	11 7/8	5/32	3 1/2	11/32	5 3/4	7	4 11/16	5 7/8	7 1/4	6 1/8
182JM	182JP	2	3	2 1/4	2 7/8	3 3/4	4 1/2	9 1/16	12 3/8	7/16	4 1/2	13/32	8 1/8	9	4 15/16	8 1/8	9 3/8	6 3/4
184JM	184JP	3	5	2 3/4	3 3/8	3 3/4	4 1/2	9 9/16	12 7/8	7/16	4 1/2	13/32	8 1/8	9	5 7/16	8 1/8	9 3/8	7 1/4

*For exact installation data, please write factory for certified dimensions

ARMSTRONG MOTOR MOUNT CENTRIFUGAL PUMPS



DIMENSIONAL DATA

SERIES 4260

ALL PUMP SIZES ARE PROVIDED WITH NPT SCREWED CONNECTIONS

PUMP

PUMP SIZE	BRANCH SIZES		A	B	C	D	E
	DISCHARGE	SUCTION					
¾B	¾	1	3	3½	3¹¹⁄₁₆	3⁷⁄₁₆	6
1B	1	1¼	3⅝	4½	3	3⅝	6
1¼B	1¼	1½	3⁹⁄₁₆	4¾	3¹⁄₁₆	3¾	6⅛
1½B	1½	2	3¾	5⅜	3⁹⁄₁₆	4	6¼

MOTOR

ALL DIMENSIONS IN INCHES*

MOTOR RATING	RPM	1750					3450				
	HP	⅙	¼	⅓	½	¾	½	¾	1	1½	2
Single Phase	X	1⁹⁄₁₆	1⁹⁄₁₆	2³⁄₁₆	2³⁄₁₆	2³⁄₁₆	2³⁄₁₆	2³⁄₁₆	2¹⁄₁₆	2¹⁄₁₆	2³⁄₁₆
	Y	2⁷⁄₁₆	2⁷⁄₁₆	3⁷⁄₁₆	3⁷⁄₁₆	3¹³⁄₁₆	3⁷⁄₁₆	3⁷⁄₁₆	3¹³⁄₁₆	4⁹⁄₁₆	4⁹⁄₁₆
Three Phase	X	—	—	—	—	—	—	—	—	—	—
	Y	2³⁄₁₆	2³⁄₁₆	2⁷⁄₁₆	2⁷⁄₁₆	4⁹⁄₁₆	2⁷⁄₁₆	3⁷⁄₁₆	3¹³⁄₁₆	4⁹⁄₁₆	4⁹⁄₁₆

*For exact installation data, please write factory for certified dimensions.

TYPICAL SPECIFICATIONS

Furnish and install, as illustrated on the plans and specifications, an Armstrong End Suction Motor Mount Centrifugal Pump...

...SERIES 4260

equipped with a water-tight, long-life, self-lubricating "ARMSEAL."

...SERIES 4280

equipped with a water-tight, long-life, self-lubricating "ARMSEAL."

...SERIES 4285

equipped with a deep stuffing box, split gland, gland packing and full-length shaft sleeve.

...SERIES 4290

equipped with double mechanical seal, seal plate and tapped connections for cooling water supply. (Auxiliary features specified separately.)

The pump shall be of the radially split casing type with back pull-out feature permitting removal of the pump internals without disturbing pipe connections. Pump construction shall be (bronze-fitted) (all-iron) (all-bronze) suitable for a maximum working pressure of 175 psig.

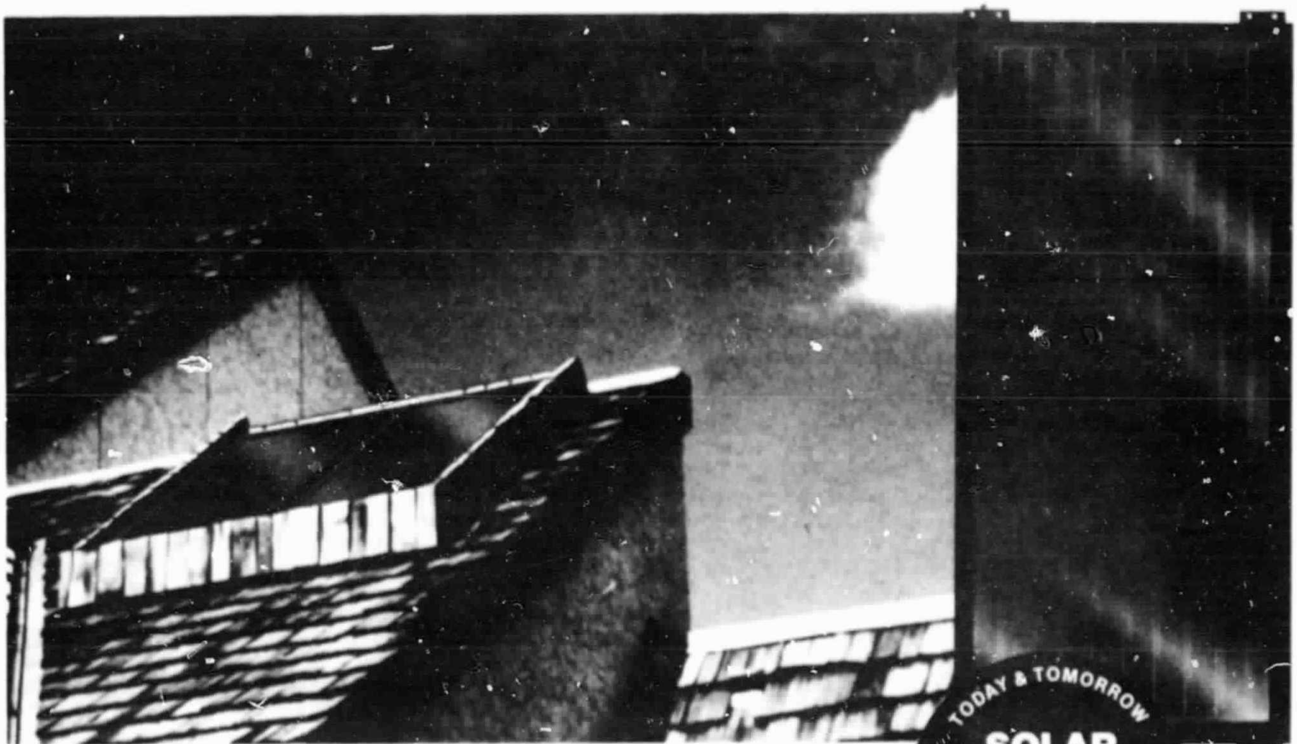
The driving motor shall be of the horizontal shaft, foot-mounted, squirrel cage induction type with NEMA "C" flange, ... enclosure, and suitable for operation on a ...... volt ...... cycle ...... phase supply.

The complete unit shall be suitable for the following service (or as shown in the pump schedule) and the pump manufacturer shall conduct running tests to verify the conditions of head and capacity specified.

SERVICE..............................	LIQUID..............................	PUMP SIZE..............................
CAPACITY...................USGPM	TEMPERATURE.......................°F.	SPEED..............................RPM
TOTAL HEAD...................FEET	VISCOSITY.......................SSU	MOTOR RATING.......................HP

Form No. 6385A 4M 8-76 HWA

Litho in U.S.A.



SG18-DG18

for Domestic Water Heating, Space Heating and Air Conditioning

FEATURES

- Heavy Duty Construction
- Floated Absorber
- All Copper Waterways
- Fully Insulated
- Low Iron Glass
- Baked Enamel Exterior
- Easy Field Access To All Components

Raypak has applied 30 years of leadership in the commercial boiler/heater industry to the development of a flat plate solar heating collector for residential, commercial and industrial applications. This advance design features all copper waterways for direct application to potable water, eliminating the need for a heat exchanger. Raypak's extensive experience in the boiler/heater industry means you get a product that meets codes and will function efficiently in your application year after year.

Raypak®

RAYPAK, INC. 31111 AGOURA ROAD, P.O. BOX 5790
WESTLAKE VILLAGE, CALIFORNIA 91359

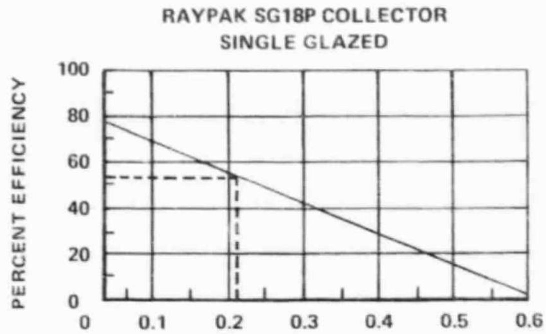
SG18-P-M-A/DG18-P-M-A
SG18-P-M-C/DG18-P-M-C

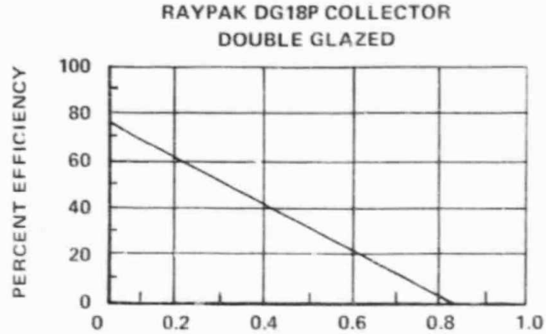
Technical Description- Sample Specification

Raypak's solar panels can be used for direct system application using water, for building heating or domestic water heating, or indirect application using a water/glycol solution (11% more panel required).

The Raypak solar panel consists of a non-ferrous heat transfer surface (absorber) and a container constructed to maximize absorptivity and minimize heat emissivity. The absorber is an all copper grid design with minimal pressure drop. The copper tubing is mechanically bonded between two sheets of copper or aluminum for maximum heat transfer. The top surface of the copper or aluminum is covered with durable semi-selective black coating.

The container is constructed of galvanized sheet steel with a baked enamel finish. The container is insulated with a rigid polyurethane foam which is sag-resistant, foil-faced on both sides, dimensionally stable and non-moisture absorbent. Insulating value is R10 and R8 respectively for bottom and sides. Glazing is 1/8" double strength tempered low iron glass to provide maximum resistance to wind load, hail impact, snow load and vandalism.

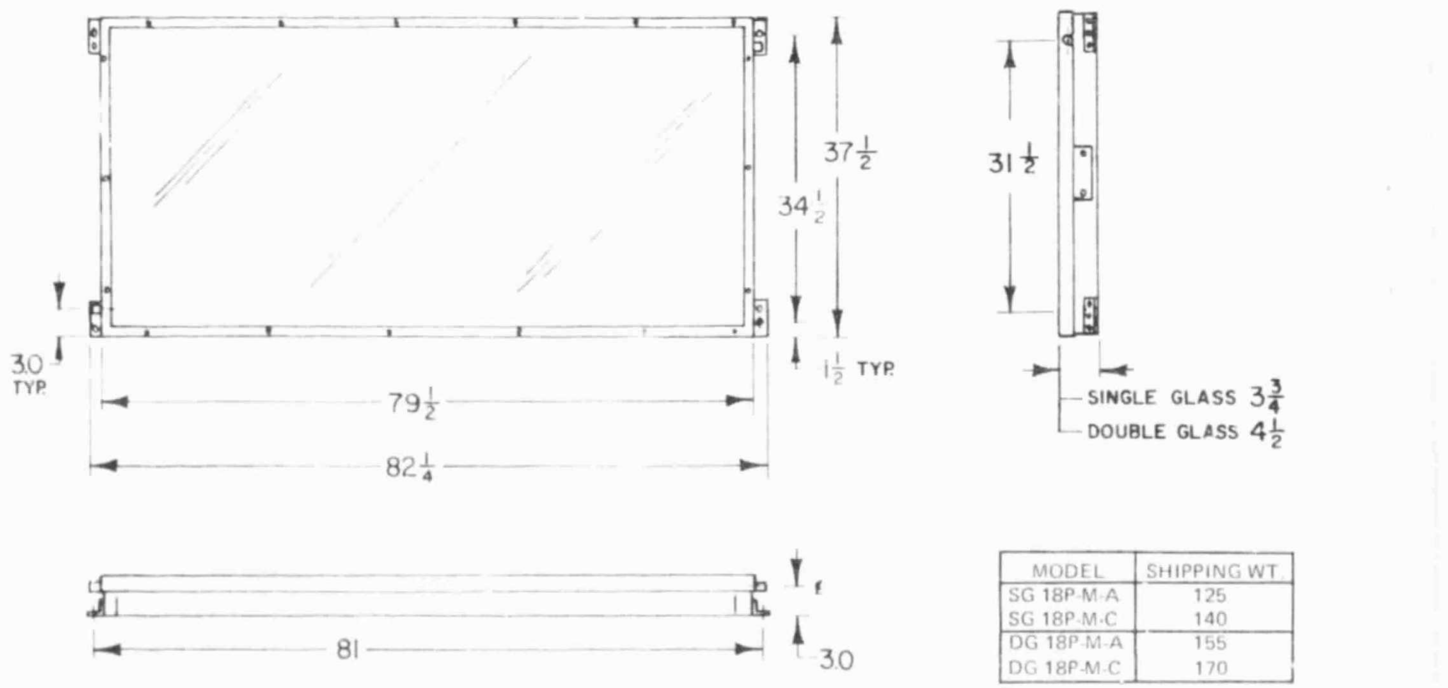




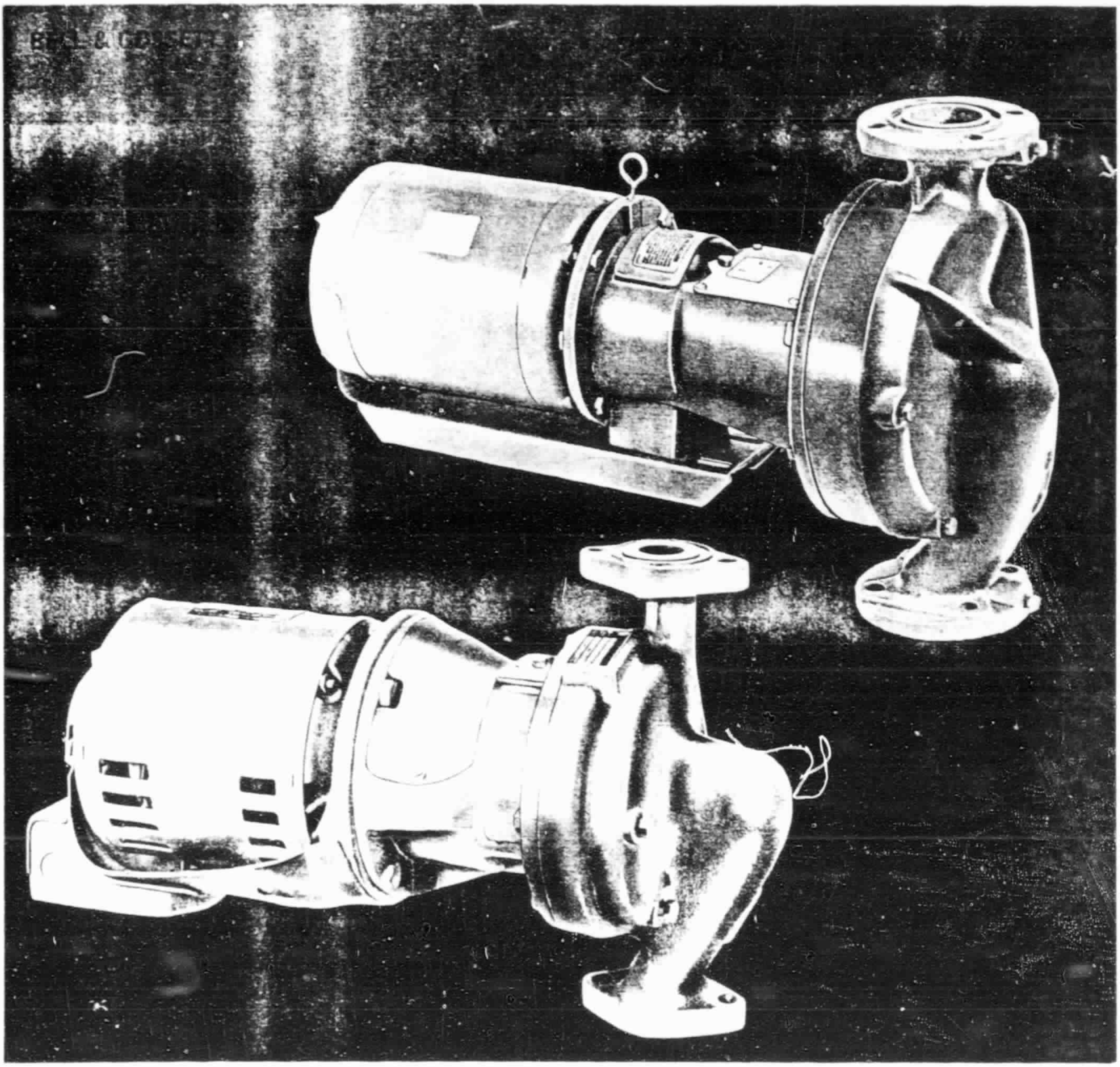
TEST CONDITIONS
Wind Speed 2-10 MPH
Insolation 150-320 BTU/HR x F^2
Ambient Temp. 65-110^oF
ALL DATA FROM DESERT SUNSHINE EXPOSURE TESTS INC.

$\frac{\bar{T}_f - T_{amb}}{Q_{inc}}$

The absorber portion of the collector is designed to withstand 150 PSI and will meet building code piping standards. The collector is capable of withstanding temperatures up to 400^{o}F with no flow of circulating media. Consult Catalog No. SP 3001-E for details on control systems.



MODEL	SHIPPING WT.
SG 18P-M-A	125
SG 18P-M-C	140
DG 18P-M-A	155
DG 18P-M-C	170



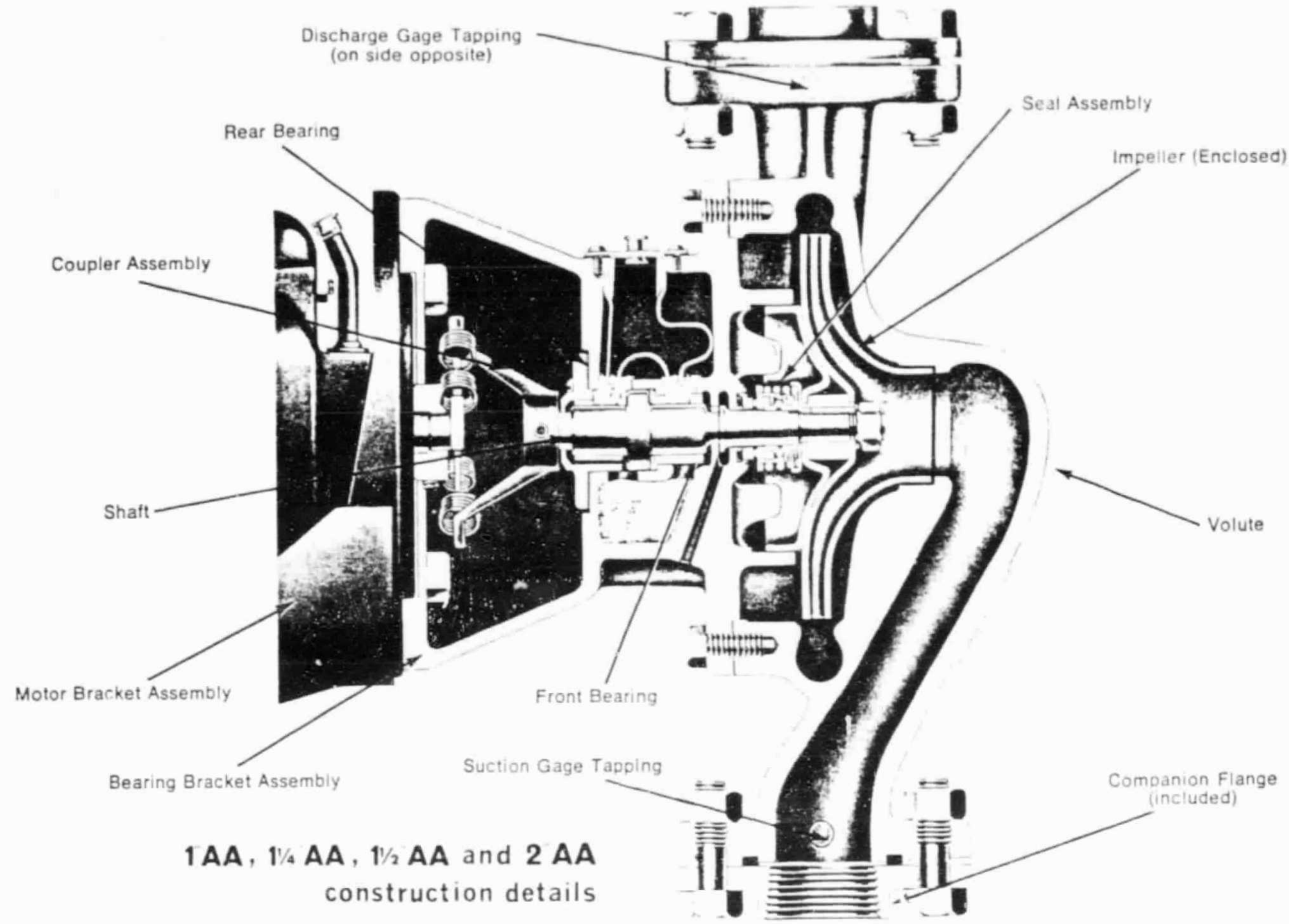
SERIES 60

the extra quiet

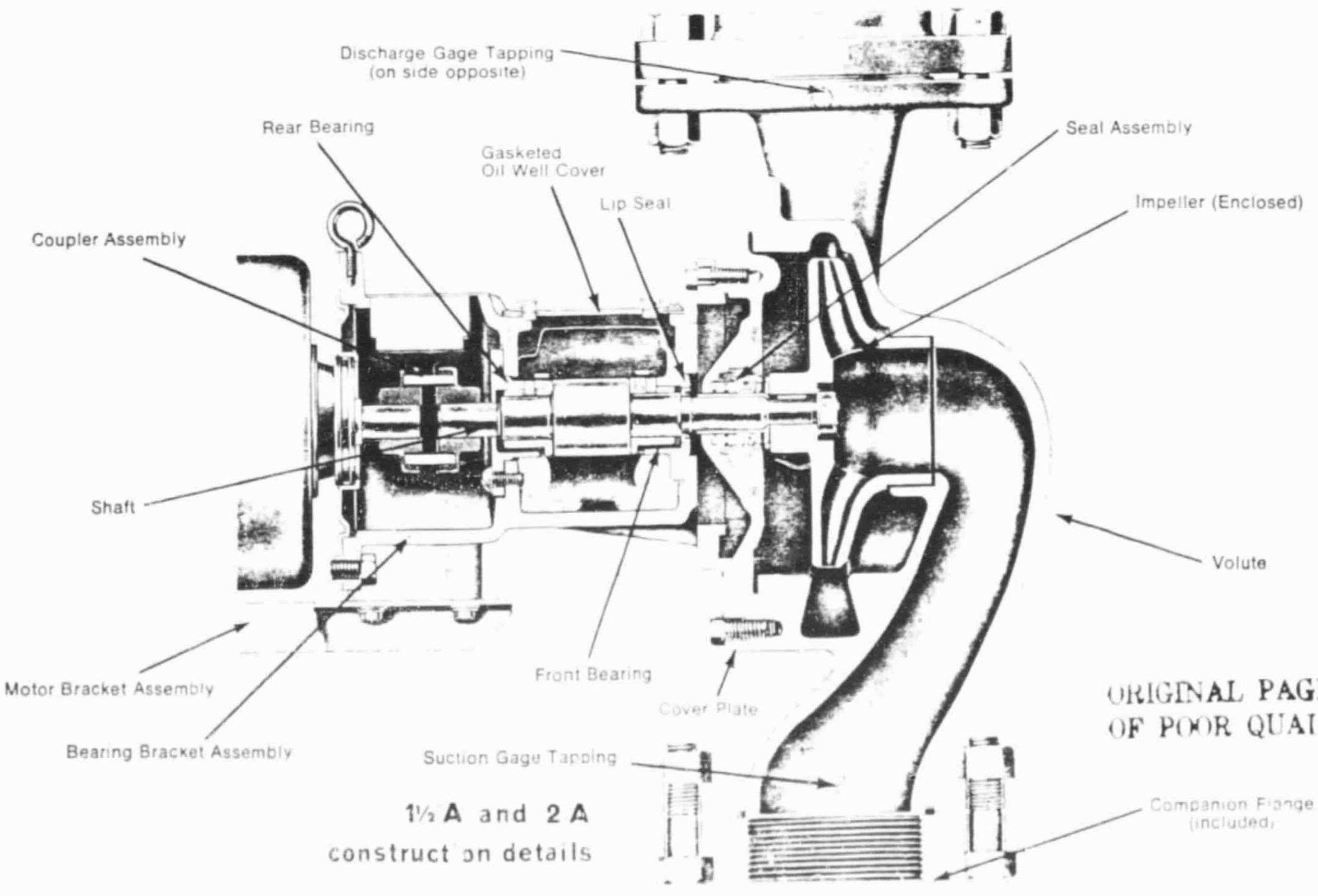
in-line pump for general services

P- 4

BELL & GOSSETT ITT
FLUID HANDLING DIVISION



1AA, 1¼ AA, 1½ AA and 2 AA construction details

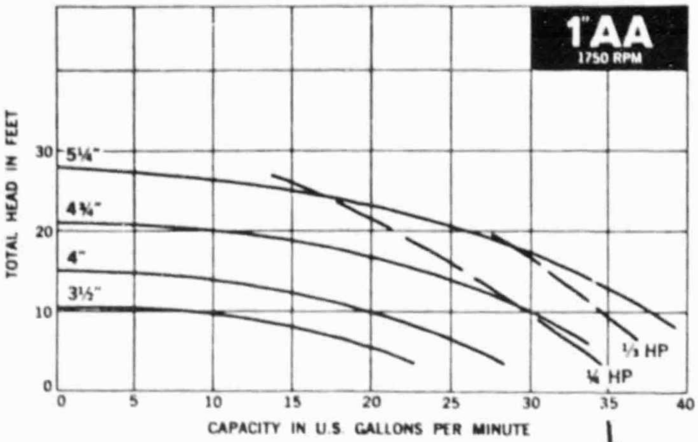


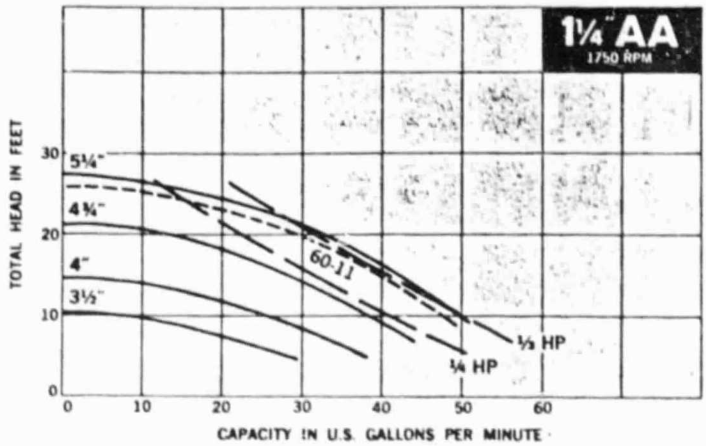
1½ A and 2 A construction details

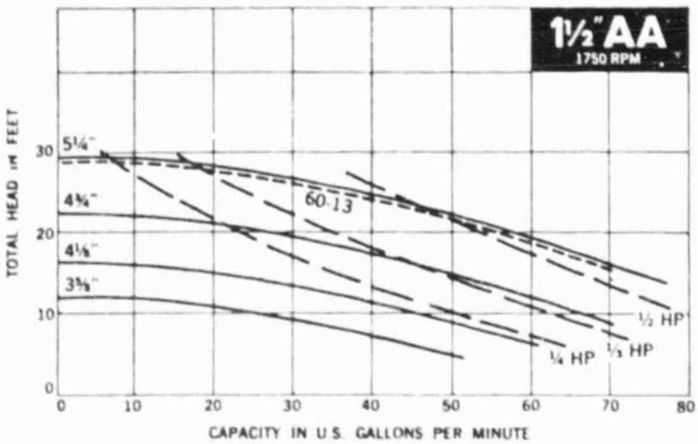
ORIGINAL PAGE IS OF POOR QUALITY

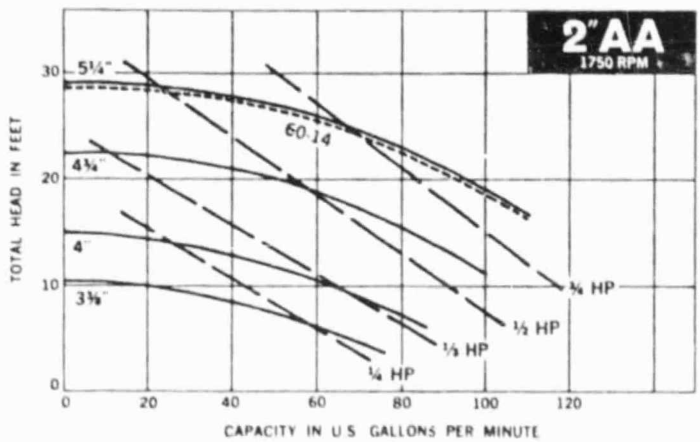
Series 60 Pumps can be furnished in bronze-fitted, all iron, or all bronze construction to suit your application

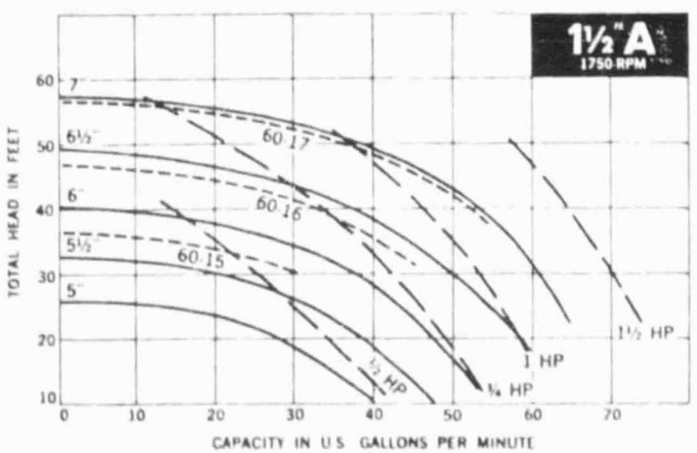
DOTTED-IN CURVES REPRESENT STOCK PUMP SELECTIONS

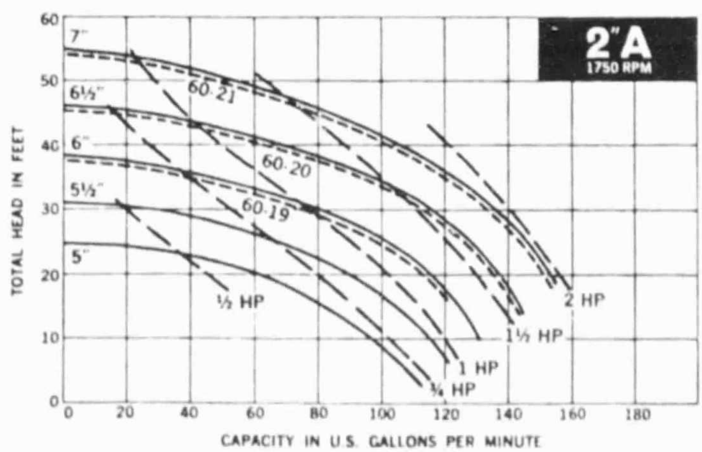












Curves based upon shop test using clear cold water at a temperature of not over 85° F. Horsepower curves do not include motor service factor.

Dimensions

FIG. 1 AA SIZES

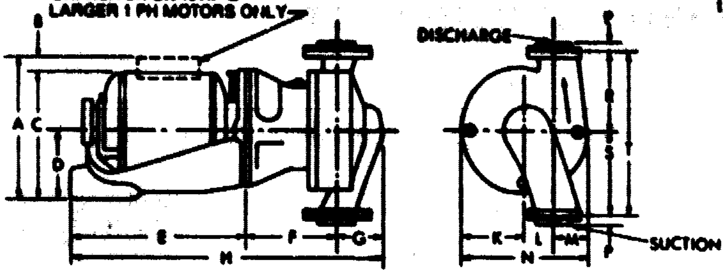
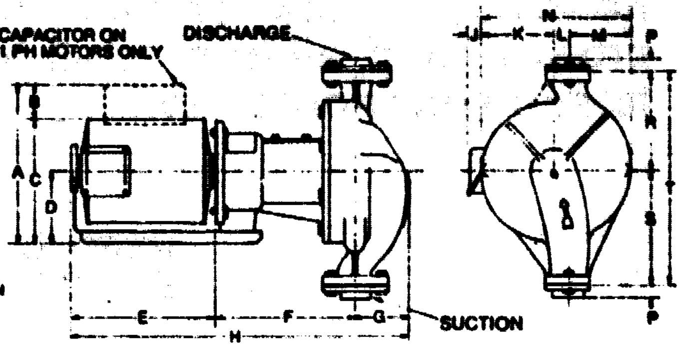


FIG. 2 A SIZES



STANDARD VOLTAGES
¼ HP, 1 PH, 115 Volts. ⅓ to 1½ HP, 1 PH, 115/230 Volts. ¼ to ¾ HP, 3 PH, 200-230/460 Volts. 1 to 2 HP, 208 or 230/460 Volts.
All single phase motors have built-in overload protection.

Companion flanges furnished for suction and discharge

STOCK PUMP MODEL	PUMP SIZE	DRIPPROOF MOTOR HP	SUCTION & DISCHARGE SIZE (NPT)	DIMENSIONS IN INCHES				
				A	B	C	D	E
–	1AA	¼	1	15 13/16	11	4⅜	6⅛	3 7/16
–	1AA	⅓	1	16 13/16	11	4⅜	6⅛	3 7/16
60-11	1¼AA	¼	1¼	15 13/16	11	5	7½	3 9/16
–	1¼AA	⅓	1¼	16 13/16	11	5	7½	3 9/16
–	1¼AA	½	1¼	17 9/16	11	5	7½	3 9/16
–	1½AA	¼	1½	16	11½	5⅛	7⅞	3⅝
–	1½AA	⅓	1½	17	11½	5⅛	7⅞	3⅝
→ 60-13	1½AA	½	1½	17½	11½	5⅛	7⅞	3⅝
–	1½AA	¾	1½	18	11½	5⅛	7⅞	3⅝
–	2AA	¼	2	16⅛	11½	5⅛	8	3¾
–	2AA	⅓	2	17⅛	11½	5⅛	8	3¾
–	2AA	½	2	17⅝	11½	5⅛	8	3¾
60-14	2AA	¾	2	18⅛	11½	5⅛	8	3¾
60-15	1½A	½	1½	20¼	13½	5⅝	9½	3¼
60-16	1½A	¾	1½	21¾	13½	5⅝	9½	3¼
60-17	1½A	1	1½	19¾	13½	5⅝	9½	3¼
–	1½A	1½	1½	20⅝	13½	5⅝	9½	3¼
–	2A	½	2	21¼	14	5¾	9⅞	3½
–	2A	¾	2	21¾	14	5¾	9⅞	3½
60-19	2A	1	2	19¾	14	5¾	9⅞	3½
60-20	2A	1½	2	20⅝	14	5¾	9⅞	3½
60-21**	2A	2**	2	21⅜	14	5¾	9⅞	3½

**Not available in single phase.

Dimensions are approximate and not to be used for construction purposes.

Construction Materials

FOR PARTS IN CONTACT WITH FLUID PUMPED

DESCRIPTION	BRONZE FITTED PUMP	ALL IRON PUMP	ALL BRONZE PUMP
Volute	Cast Iron	Cast Iron	Bronze
Bearing Bracket	Cast Iron	Cast Iron	Iron with Brass Face Plate
Impeller	Brass	Steel (AA)/Cast Iron (A)	Brass
Impeller Key	Steel	Steel	Steel
Impeller Lock Washer	Steel	Steel	Brass
Impeller Lock Nut	Brass (AA) Steel (A)	Plated Steel	Brass
Pump Shaft	Steel	Steel	Steel
Shaft Sleeve	Copper	Stainless Steel	Copper
Seal Assembly	Carbon Seal Ring, Ceramic Seat, Synthetic Rubber Bellows and Stainless Steel Spring		

APPENDIX D

VERIFICATION

La Quinta
MOTOR INNS, INC.

VERIFICATIONS

1. **Final Field Inspection**

   A team consisting of Jay Forester, Ronald Wang (Owner's Representative), Douglas Westrope, Jr., Houston M. Hammac, and W.T. Powers (Department of Energy Representatives) met for final inspection on April 23, 1980 through April 25, 1980.

   The installation was found to be complete and operating as called for in the plans. The control system was checked out and confirmed to be performing as designed.

2. **Data Obtained During Final Field Inspection**

   Please see attached sheets.

3. **Acceptance**

   The installation is considered complete and accepted.

Ronald K. Wang
Mechanical/Electrical Engineer
Development Division
LA QUINTA MOTOR INNS, INC.

RW:cs

Development Division
Century Building • P.O Box 32733 • San Antonio, Texas 78216 • [illegible]

LA QUINTA/LAS VEGAS, NV MOTEL OBSERVATIONS

1. Operation Logic:

Collector-to-Storage	$\Delta T = 20^{\circ}$ F - Flow on, P6 or P7 plus Storage Recirculation Pump P5
Collector-to-Storage	$\Delta T = 3^{\circ}$ F - Flow Off
Storage-to-Load	$\Delta T = 8^{\circ}$ F - Flow On, P4 plus Storage Recirculation Pump P5
Storage-to-Load	$\Delta T = 4^{\circ}$ F - Flow Off

2. Collector Loop @ 50 gpm nominal 5F° rise
@ 25 gpm nominal 10F° rise
Load Loop @ 48 gpm nominal 2F° rise

During periods of high flow usage when washing machines are calling for water, the ΔT rise is approximately 10° F. The load HX inlet will be approximately 70° F and the outlet will be approximately 80° F when solar storage at mid-tank is about 105° F.

Flow in the collector loop was reduced from 50 gpm to 25 gpm, but flow in the load loop could not be reduced from the current 48 gpm with pump P4 on because current plumbing requires all CWS makeup to pass through pump P4 prior to entering the motel DHW supply. The motel usage may demand greater than 25 gpm at periodic intervals.

3. The supplementary DHW tank heating elements were noted to be operational during very brief intervals, and operation was only during the period of heavy laundry usage. Even then, no more than two element pairs were ever noted as activated.

4. Load loop HX piping in mechanical room is not insulated permitting unnecessary loss of energy.

5. Load loop HX piping connections to DHW tank are both at about one-quarter height of tank. The inlet to the HX is approximately 1 1/2 inches above the outlet from the HX. There is no baffle and both are open at the same penetration into the tank.

During the course of an operating day, there are periodic intervals that energy is removed from the DHW tank and passed back to the solar storage tank.

This can be attributable to the inlet and outlet HX plumbing connection as it now exists at the 750 gallon DHW tank. It is also influenced by an apparent insulated affect of the load loop temperature control sensor installed in the DHW tank. This sensor never exceeded 110° F even when other measurements indicated the temperature in the bottom of the tank exceeded 118° F.

1. On April 24, 1980, at 7:16 a.m., the insolation was measured as being 60 BTUH per square foot and at 4:16 p.m., it was measured as being 70 BTUH per square foot. The insolation peaked between 11 a.m. and 1 p.m. at 265 BTUH per square foot. During the 9-hour period of measurement, approximately 3,423,600 BTU's were available for collection. There were approximately 957,000 BTU's collected. During the period between 11 a.m. and 1 p.m., approximately 636,000 BTU's were available for collecting and about 212,600 BTU's were collected. This translates into a collector loop system efficiency of about 33 percent during conditions which rate the collector efficiency at about 34 percent.

2. In the load loop between the hours of 11 a.m. and 1 p.m. at a flow of 48 gpm with a nominal temperature rise of 2F°, approximately 96,000 BTU's were transferred to the DHW tank. This converts to about 28 kWh. Pumps P4, P5 and P6 used about 2 kWh yielding approximately 26 kWh gained.

3. During a period from 8:50 a.m. to 9 a.m., a 5 gpm flow to washer produced a 10F° rise across the HX. The inlet was 70° F and the outlet was 80° F. The solar storage at mid-tank was about 105° F. The BTU gained from solar storage was about 4,170 BTU's which translates into 1.2 kWh.

4. Based upon the measurements recorded during the April 23, 1980, to April 25, 1980, period, on days that insolation achieves at least 265 BTUH per square foot between the hours of 11 a.m. and 1 p.m., 900,000 BTU to 1,000,000 BTU will be deposited into solar storage during the total collection period. Usage will occur simultaneously with collection throughout the day. Solar energy collected exceeded the requirements for heating DHW usage during the day. Therefore, the excess collected remained in storage raising the solar storage tank by 21F° from about 106° F to approximately 127° F. This translates into approximately 437,000 BTU to be given up by solar storage during evening, night and early morning usage prior to reactivation of solar collection. This appears that about 54 percent of the energy collected is used during the day and the other 46 percent is available during the non-collection hours. By conservative estimates, 90 percent of the energy given up by solar storage will be transferred to motel usage through the DHW tank during daytime usage. Converting 90 percent of the BTU into kWh yields 135.3 kWh. Subtracting the parasitic energy consumed by pumps P4, P5 and P6 during this period leaves approximately (135.3 - 17.3) 118 kWh. During the designated nighttime operation in which the remaining 46 percent is available, 85 percent of the energy will be transferred for motel usage through the DHW tank. Converting 85 percent of the BTU into kWh yields approximately 103.8 kWh. Modifying this quantity by the parasitic energy consumed by pumps P4 and P5 leaves approximately (103.5 - 8.8) 95 kWh. Therefore, for each day approximately 213 kWh will be gained from solar. At current electric rates of $0.0485 per kWh in Las Vegas, NV, this trans-

lates into about $10.30 per day contributed to the motel by solar.

Houston M. Hammac

Houston M. Hammac
Site Equipment and Assessment Group
May 6, 1980

LA QUINTA/LAS VEGAS, NV, MOTEL CALCULATION SHEET

265 BTUH/FT^2 peak for the day

Collected: 950,000 BTU
Usage: 513,000 BTU from 8 a.m. to 5 p.m. (Day)
437,000 BTU from 5 p.m. to 8 a.m. (Night)

Useful Recovery: Day @ 90%
Night @ 85%

Pump Wattage Consumption Rates: P4 @ 660 wh
P5 @ 185 wh
P6 or P7 @ 1100 wh

P4 & P5 between 5 p.m. and 11 p.m. @ 99% runtime
(660 + 185) * 6 * .99 = 5 kWh
P4 & P5 between 11 p.m. and 8 a.m. @ 50% runtime
(660 + 185) * 9 * .99 = 3.8 kWh

P4 & P5 & P6 between 8 a.m. and 5 p.m. @ 99% runtime
(660 + 185 + 1100) * 9 * .99 = 17.3 kWh

Day (from 8 a.m. to 5 p.m.)
513,000 BTU * .9 ÷ 3413 = 135.3 kWh
less parasitic losses = 17.3 kWh
yields effective energy contribution = 118 kWh

Night (from 5 p.m. to 8 a.m.)
416,700 BTU * .85 ÷ 3413 = 103.8 kWh
less parasitic losses = 8.8 kWh
yields effective energy contribution = 95 kWh

Total per day energy contribution:
118 kWh + 95 kWh = 213 kWh

@ $0.0485 per kWh electric rates:
213 kWh * 0.0485 = $10.30 per day.

Houston M. Hammac
Houston M. Hammac
Site Equipment and Assessment Group
May 6, 1980

LA QUINTA/LAS VEGAS, NV, MOTEL RECOMMENDATIONS

1. Ensure that the modification to add two gas-fired DHW tanks is installed in a manner not detrimental to the solar contribution. The additional recirculation pump should not run when the load circulation pump P4 is operating. This is accomplishable in a manner similar to the attached Figure 1 enclosure.

2. The load HX piping in the mechanical room should be insulated to minimize losses to the room space.

3. Ensure baffles or some diverting scheme is installed in the 750 gallon DHW tank between the inlet and outlet to the load HX. Return from load HX connection point to the 750 gallon DHW tank should be at the higher level relative to the supply to the load HX connection point from the DHW tank.

4. Ensure the load loop temperature control sensor in the DHW tank is performing properly by responding to actual temperatures correctly and that it remains exposed to dynamic fluid conditions.

Incorporation of recommendations 3 and 4 should preclude the tendency to remove energy from the DHW tank to solar storage during transition periods.

5. The solar storage recirculation pump P5 should not operate except when pump P6 or P7 is operating, permitting maximum advantage of statification in the solar storage during non-collection periods.

6. Ensure the functionality of the expansion tank in the solar loop.

7. Modify the CWS makeup for the motel usage to the outlet of load circulation pump P4 permitting the flow to be reduced to 25 gpm. This will accomplish a higher temperature rise across the heat exchanger. The increase in sensible heat will effect greater energy transfer with less quantity of fluid decreasing pump P4 runtime.

8. The thermostat for the gas-fired DHW tanks should be set to come ON at 110° F and go OFF at 120° F. The recirculation line must be insulated to minimize losses and on time of the gas heat.

9. The collector loop should remain at 25 gpm to effect a greater temperature drop than will occur at 50 gpm. This will permit inlet temperature to the collectors to remain lower thus collector efficiency will be greater.

10. For any future installations, the pumps should be sized for required fluid flow to minimize parasitic energy consumption.

Houston M Hammac

Houston M. Hammac
Site Equipment and Assessment Group
May 6, 1980

6. The collector loop expansion tank appears fully charged with no expansion functionality permitted in the tank.

7. On days when insolation reaches at least 265 BTUH per square foot between 11 a.m. and 1 p.m., the solar storage will be raised to approximately 127° F at mid-tank.

Overnight usage will not drop the solar storage tank below approximately 106° F at mid-tank.

8. Between the hours of 6 a.m. and 11 p.m., the load loop HX circulation pump P4 and the solar storage recirculation pump P5 operate about 99 percent of the time and between the hours of 11 p.m. and 6 a.m., operation is about 50 percent of the time.

Houston M. Hammac

Houston M. Hammac
Site Equipment and Assessment Group
May 6, 1980

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